BC hydro

Environmental Planning
and Assessment Report

Fraser Valley System Reinforcement Project

June 1991

Report No. ER-91-11

proud of our Service

BC
B685
D: F72 Eb
1991
c.3

Canadian Cataloguing in Publication Data
B.C. Hydro
Fraser Valley System Reinforcement Project
environmental planning and assessment report.

ISBN 0-7726-1369-9

1. Electric substations - Environmental aspects - British Columbia
2. Electric power transmission - Environmental aspects -
British Columbia. I. Title

TD 195.E37B115 1991 621.31'26 C91-092210-1

92-00226/

FRASER VALLEY SYSTEM REINFORCEMENT PROJECT

ENVIRONMENTAL PLANNING AND ASSESSMENT REPORT

B.C. HYDRO
ENVIRONMENTAL RESOURCES
CORPORATE AND ENVIRONMENTAL AFFAIRS

JUNE 1991

Report No. ER-91-11

Environmental Planning and Assessment Report

Fraser Valley System
Reinforcement Project

Prepared by: _____
Mark Walmsley (Consultant - Westland Resource Group)

Recommended by: _____
Colin Gumsey, Andy Grikis, Hugh Smith

Approved: _____
F.G. Hathorn

Date: 13 JUNE 1991

B.C. Hydro
Environmental Resources
Environmental and Corporate Affairs

June 1991

TABLE OF CONTENTS

		Page
EXECUTIVE SUMMARY		iv
PREFACE		v
1.0 INTRODUCTION		1
1.1 Background Information		1
1.1.1	Purpose of the Project	1
1.1.2	Project Description	1
1.2 Regulatory Requirements		1
2.0 IDENTIFICATION AND EVALUATION OF SYSTEM REINFORCEMENT OPTIONS		2
2.1 Identification of System Reinforcement Options		2
2.2 Evaluation of System Reinforcement Options		4
2.2.1	Site 1 - McLellan Substation	4
2.2.2	Site 2 - Clayburn Substation	6
2.2.3	Site 3 - Atchelitz Substation	6
2.3 Comparison of Alternatives and Selection of Best Environmental Alternative		9
3.0 PROJECT OVERVIEW AND SCHEDULE		13
4.0 BRIEF TECHNICAL DESCRIPTION OF THE PROPOSED SYSTEM REINFORCEMENT		16
4.1 Location of Transmission Line and Substation Expansion		16
4.2 Design		16
4.3 Construction Methods		17
4.3.1	Right-of-Way Clearing	17
4.3.2	Access Road Construction	17
4.3.3	Structure Foundation Installation	17
4.3.4	Structure Assembly and Erection	18
4.3.5	Conductor Installation	19
4.3.6	Site Restoration	19
4.3.7	Right-of-Way Maintenance	19
4.3.8	Substation Expansion	20
4.4 Right-of-Way Requirements		20
4.5 Substation Equipment		20

5.0 ENVIRONMENTAL DESCRIPTIONS AND CONSIDERATIONS 21
5.1 Climate and Air Quality 21
5.1.1 Climate 21
5.1.2 Air Quality 21
5.2 Topography, Geology and Soils 21
5.2.1 Topography 21
5.2.2 Geology and Soils 21
5.3 Land Use 22
5.4 Water Resources 23
5.5 Ecology 25
5.5.1 Terrestrial 25
5.5.1.1 Vegetation and Forestry 25
5.5.1.2 Wildlife 25
5.5.2 Aquatic 25
5.5.3 Wetlands and Floodplains 26
5.5.4 Threatened and Endangered Plant and Animal Species 26
5.5.4.1 Wildlife 26
5.5.4.2 Plant Life 26
5.6 Socio-economic 26
5.6.1 Demographics 26
5.6.2 Economic Conditions 27
5.6.2.1 Overview of Area Economy 27
5.6.2.2 Economic Impact of Substation Construction 27
5.7 Visual and Recreation Resources 28
5.7.1 Visual 28
5.7.2 Recreation 30
5.8 Heritage Resources 30
5.9 Electric and Magnetic Fields 30
5.10 Radio and Television Interference 33
5.11 Audible Noise 34
5.12 Special Considerations 34

6.0 CONSTRUCTION AND OPERATION MITIGATION 35
6.1 Water Quality and Use 35
6.2 Fisheries 35
6.3 Floodplain Management 36
6.4 Wildlife 37
6.5 Socio-economic and Land Use 37
6.6 Visual and Recreation 37
6.6.1 Visual 37
6.6.2 Recreation 37
6.7 Heritage Resources 38
6.8 Electric and Magnetic Fields 38
6.9 Special Considerations 38

7.0 CONCLUSIONS AND RECOMMENDATIONS 40

APPENDICES

APPENDIX 1. Photographs of the Clayburn Substation area 41
APPENDIX 2. Willband Creek Floodplain Development Permit Area 46
APPENDIX 3. Investigation of Volatile Organic Compounds at the Matsqui Landfill Site 48

LIST OF FIGURES

Figure 1. Major Transmission Lines and Substations in the Central Fraser Valley . . 3
Figure 2. McLellan 500 kV Transmission Loop from 5L41 5
Figure 3. Clayburn 500 kV Addition and 500 kV Transmission Loop from 5L41. . . 7
Figure 4. Atchelitz 500 kV Addition and 500 kV Loop from 5L41. 8
Figure 5. Clayburn Substation and Surrounding Area 12
Figure 6. Examples of Tower Structure Design for 500 kV Loop 14
Figure 7. Environmental and Land Use Features of the Study Area 24
Figure 8 Clayburn Substation Playing Fields. 32

LIST OF TABLES

Table 1. Overall Environmental Impact Analysis Rating for Transmission Line Reinforcement Alternatives (see definitions of constraint ratings) 11
Table 2. Fraser Valley 500 kV Substation Reinforcement Project Schedule 15
Table 3 Comparison of Growth Rates 27
Table 4 Labour Force Requirements 29

LIST OF PLATES

Plate 1 Willband Creek floodplain; looking west within existing right-of-way. . . . 42
Plate 2 View southwest from proposed site for 500 kV substation 42
Plate 3 View north across landfill site toward proposed site for 500 kV substation in background (higher ground). 42
Plate 4 View north from proposed site for 500 kV substation to existing Clayburn Substation. 42
Plate 5 View south from existing Clayburn Substation to proposed site for 500 kV substation. 42
Plate 6 Erodible soils on steep topography south of proposed 500 kV substation. 42

EXECUTIVE SUMMARY

The project under study is the reinforcement of transmission facilities in the south central Fraser Valley to meet the anticipated growth in demand for electricity. This objective could be met by reinforcing (adding 500 kV equipment and connection to transmission line 5L41) substation facilities at McLellan Substation in Surrey, at Clayburn Substation in Matsqui or at Atchelitz Substation in Chilliwack.

In 1989, B.C. Hydro initiated environmental, engineering and technical studies as well as a public consultation program that examined potential substation reinforcement options as part of a study that included the examination of a transmission line interconnection with Puget Sound Power and Light (a Washington State Utility). The results of these studies are provided in separate documents.

This report provides an assessment of the environmental evaluation criteria applied to three potential sites for substation reinforcement and the rationale for the selection of the Clayburn substation site as the environmentally most effective alternative for substation reinforcement. In addition, the report describes the results of an environmental assessment and mitigation plan for the Clayburn substation reinforcement. The reinforcement of the Clayburn site will involve a 500 kV substation expansion and a 500 kV loop from B.C. Hydro's existing transmission corridor (Circuit 5L41).

The environmental studies undertaken to date result in the following conclusions:*

1. *The most effective alternative for the substation reinforcement is an expansion to the existing substation facilities at Clayburn. The Clayburn site is already cleared and managed for the 230 kV substation; environmental, land use and socio-economic impacts are considered manageable. In addition, mitigation measures can be implemented to reduce the environmental impacts the expansion might have.*

2. *The utilization of the existing right-of-way for the 500 kV loop into the Clayburn Substation is the best environmental alternative.*

3. *The most significant factors that will require possible mitigative measures include: fisheries, water quality, floodplain management, visual and recreation, and heritage resources.*

** The term environmental as used in this report includes both natural and social environmental issues.*

PREFACE

This report summarizes the results and conclusions of the environmental studies which have been conducted for the purpose of selecting the best overall option for reinforcement of the 230 kV transmission line system. The purpose of the studies is to aid in the selection of a substation and 500 kV transmission line loop for the proposed reinforcement in the south central Fraser Valley as well as to provide an assessment of environmental impacts and mitigation strategies necessary to protect the environmental resources of the selected alternative.

This report provides a summary of environmental information gathered by B.C. Hydro personnel and consultants retained by B.C. Hydro. Detailed information is provided in the consultant reports including maps which illustrate the geographic location of features discussed in this report. Mitigation measures designed to reduce or eliminate adverse environmental impacts are provided in this report for the expansion to the Clayburn substation based on the data and evaluation presented in this report. The Clayburn Substation site appears to provide the least impact and greatest possibility for the implementation of mitigation techniques.

In addition to studying the requirements and impacts of a 500 kV substation site, B.C. Hydro and the consultants investigated route and alignment alternatives for a 230 kV intertie with Puget Sound Power and Light. The intertie proposal was studied with the substation reinforcement because the two projects could share common facilities; however, the substation reinforcement is not dependent on the intertie and will proceed regardless of the status of the intertie proposal. The interconnection with Puget Sound Power and Light (PSPL) is no longer being advanced by B.C. Hydro. Consequently, this report deals specifically with the substation reinforcement component.

The environmental consultants retained by B.C. Hydro for this work and their disciplinary responsibility are noted as follows:

Coordination	-	Mark Walmsley (Westland Resource Group)
Agriculture and Soils, Fisheries, Wildlife, Vegetation and Forestry and Water Use	-	Norecol Environmental Consultants Ltd.
Visual and Recreation	-	Life-Space Designs Ltd.
Heritage	-	Points West Heritage Consulting
Socio-economic and Land Use	-	UMA Engineering Ltd.

1.0 INTRODUCTION

1.1 Background Information

1.1.1 Purpose of the Project

B.C. Hydro has proposed the reinforcement of the 230 kV transmission line facilities supplying the south central and eastern Fraser Valley. Reinforcement of the existing high voltage (230 kV) system is necessary due to the increasing demand for electricity in the Fraser Valley which is expected to fully utilize the existing system by the mid 1990s. The construction of the proposed expansion would begin in 1993 for a proposed in-service date of October 1994.

1.1.2 Project Description

Meeting the electrical needs of the south central and eastern Fraser Valley can be achieved by constructing a 500/230 kV substation and 500 kV transmission line loop at one of three existing 230 kV substations: McLellan; Clayburn; or Atchelitz.

In addition to the substation reinforcement, Puget Sound Power and Light (PSPL) and B.C. Hydro have investigated the possible construction of a 230 kV intertie between the two utilities. B.C. Hydro studied the substation reinforcement and the intertie together because of the possibility of the two components sharing common facilities, in which case, a 230 kV switching station would be required in addition to the 500/230 kV substation. B.C. Hydro is no longer advancing studies into the intertie with PSPL.

1.2 Regulatory Requirements

The construction and operation of a new 500/230 kV substation or the expansion of an existing substation, will require that an Application for an Energy Project Certificate be made to the Minister of Energy, Mines and Petroleum Resources. This report and the technical and environmental studies will be submitted as background information in support of the application.

B.C. Hydro will ensure that all Federal, Provincial, and Municipal environmental protection approvals, permits and licences will be obtained, where required, for the proposed substation expansion and 500 kV loop, throughout the planning, design, construction and operation phases of the substation.

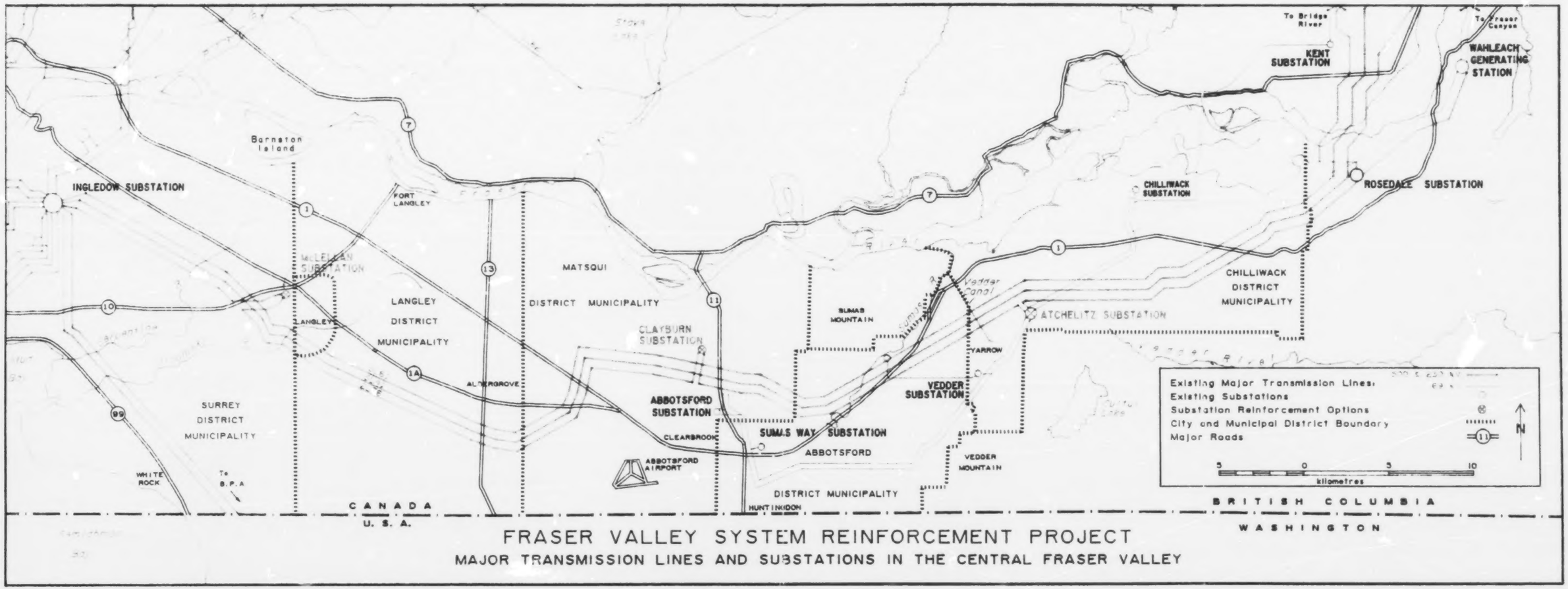
2.0 IDENTIFICATION AND EVALUATION OF SYSTEM REINFORCEMENT OPTIONS

2.1 Identification of System Reinforcement Options

Technically feasible substation sites within the study area were initially identified by B.C. Hydro in October 1988 as part of the PSPL intertie studies. In total, five (5) alternatives for the substation reinforcement were identified. Each of the sites met the requirements of station engineering/location, environmental concerns as well as the location of acceptable route alternatives for the initial purposes of the Puget Sound Power and Light Intertie Project.

The present study, which is the subject of this report, has identified three (3) options for meeting the electrical system reinforcement needs of the south central and eastern Fraser Valley. These options were identified by B.C. Hydro and include the addition of 500 kV capability to one of three existing 230 kV substations in the south central Fraser Valley namely McLellan Substation, Clayburn Substation or Atchelitz Substation.

These three existing substations are shown in Figure 1. All three existing substations are located in proximity to the major transmission line corridor running generally east-west through the southern Fraser Valley. The substations are connected to the 230 kV transmission line (2L76) which shares the corridor with two 500 kV lines (5L41 and 5L81). McLellan substation is situated in the western-most side of the study area in the Surrey District Municipality adjacent to the border with the City of Langley. Clayburn substation is located in the Matsqui District Municipality, immediately north of Clearbrook and west of the Abbotsford - Mission Highway (Highway 11). Atchelitz substation is located in the Chilliwack District Municipality, northeast of the Village of Yarrow.



FRASER VALLEY SYSTEM REINFORCEMENT PROJECT

MAJOR TRANSMISSION LINES AND SUBSTATIONS IN THE CENTRAL FRASER VALLEY

FIGURE 1

2.2 Evaluation of System Reinforcement Options

The following material provides an evaluation of each site alternative based on environmental, socio-economic, and land use criteria.

2.2.1 Site 1 - McLellan Substation

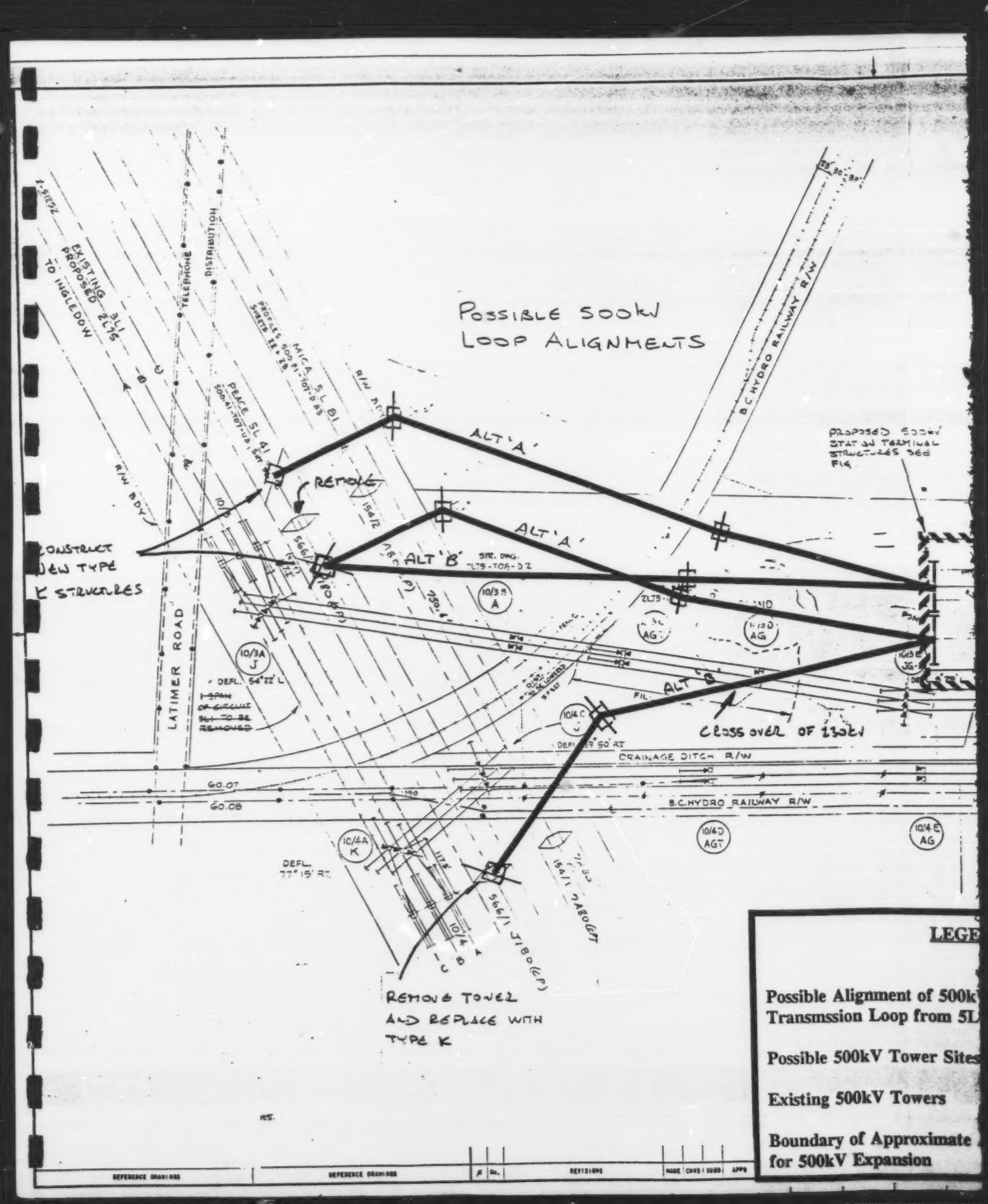
McLellan Substation is located on the northern edge of the Nicomekl River floodplain. Land use adjacent to the substation is primarily commercial/industrial to the north and west and residential to the east. South of the substation, the Nicomekl River floodplain occurs where the land is primarily left in a natural state for purposes of flood control and waterfowl/fisheries habitat protection. With the exception of the southern perimeter which contains a disused railway right-of-way, the substation is surrounded by deciduous tree vegetation and grass/shrub cover. Drainage from the site is to the south, into the Nicomekl River.

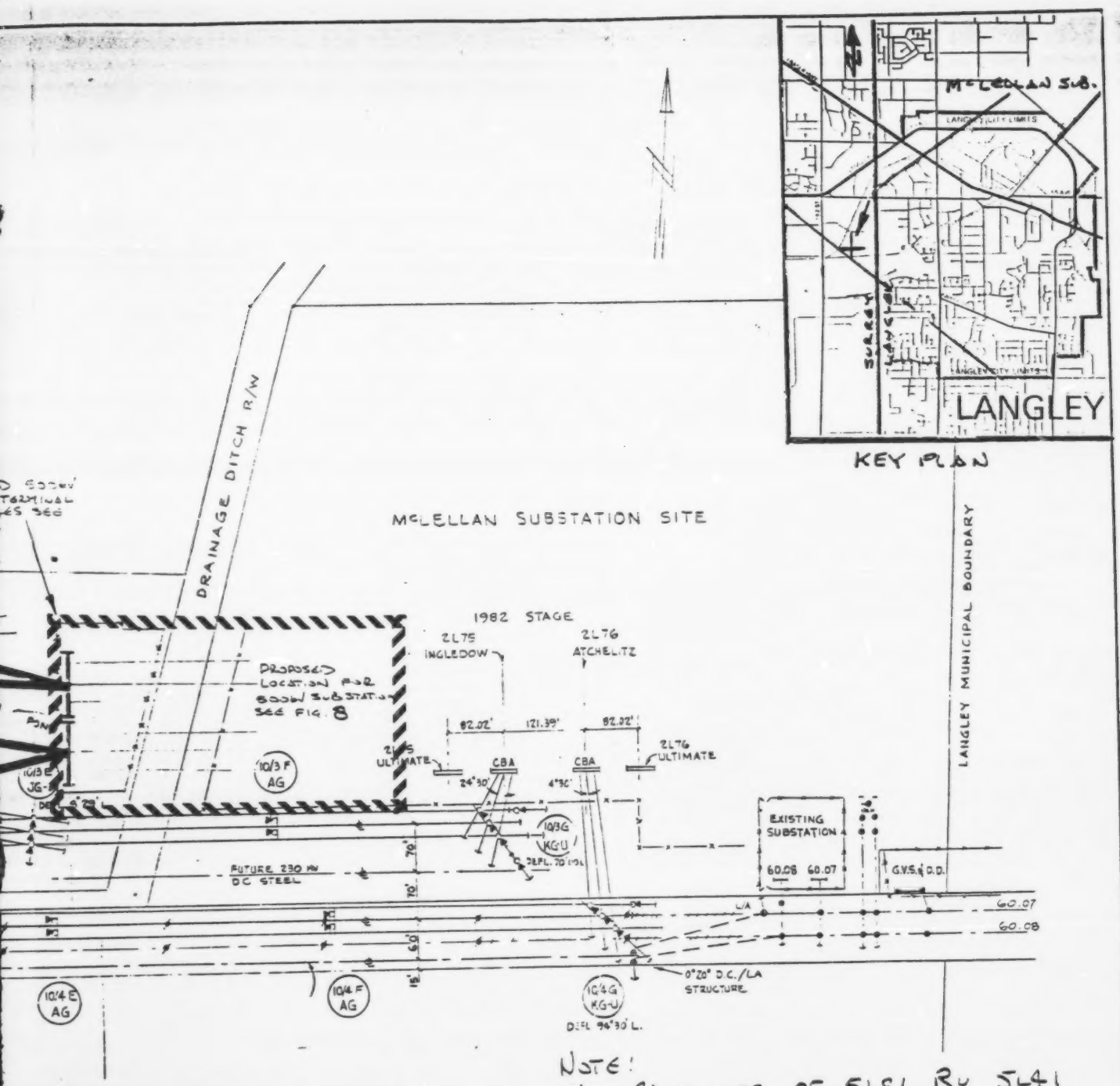
The soils surrounding the existing substation are considered suitable for agricultural use once they have undergone drainage improvements. They are generally poorly drained, fine-textured marine sediments with textures ranging from silty clay to clay. Soils in the Nicomekl floodplain are also fine textured and are very poorly drained.

There are no recorded or reported heritage or archaeological sites present in the vicinity of the substation.

Figure 2 shows the detailed location of the existing substation, the proposed expansion of the substation and two alternatives for connecting the substation to the 500 kV transmission line. The area required for the substation expansion beyond the existing substation property is approximately 5000 m^2 or one-half hectare. Vegetation will need to be cleared to accommodate the substation expansion. Due to the location of the substation adjacent to the Nicomekl River floodplain, there is concern regarding the impact of the construction on fisheries and wildlife (mainly waterfowl) in this sensitive habitat. A drainage ditch which flows south into the Nicomekl River will need to be spanned by the transmission facilities.

As a consequence of the low urban use and mixed commercial/industrial land use of the surrounding area, social and economic impacts are considered to be low. While on their own, the visual impacts of the substation expansion and transmission facilities are considered high, the existing profusion of transmission and distribution lines as well as the present substation, tends to result in the visual impacts of the proposed expansion being muted.


POSSIBLE 500kV
LOOP ALIGNMENTS
EXISTING
PROPOSED 3L1
2L75
TO INGLEDOW
TELEPHONE
DISTRIBUTION
PEACE 5L A1
MICA 5L B1
R/W BDY
ALT 'A'
REMOVE
ALT 'B'
STR. DWG.
2L75-T05-D2
ALT 'A'
ALT 'C'
CONSTRUCT
NEW TYPE
K STRUCTURES
LATIMER ROAD
10/3A
J
DEFL. 54°22' L
1-SPAN
OF CIRCUIT
3L1 TO BE
REMOVED
10/3 B
A
10/3 C
AG
10/3 D
AG
10/3 E
JG
10/4 C
J
DEFL 59° 50' RT
CLOSS OVER OF 230kV
PROPOSED 500kV
STATION TERMINAL
STRUCTURES SEE
FIG
B.C. HYDRO RAILWAY R/W
DRAINAGE DITCH R/W
60.07
60.08
B.C. HYDRO RAILWAY R/W
10/4C
AGT
10/4E
AG
10/4A
K
DEFL
77°15' RT.
566/1 JIBO(LP)
154/1 JABOUGT
REMOVE TOWER
AND REPLACE WITH
TYPE K
LEGE
Possible Alignment of 500k
Transmssion Loop from 5L
Possible 500kV Tower Sites
Existing 500kV Towers
Boundary of Approximate
for 500kV Expansion



LEGEND

- ...nent of 500kV ...oop from 5L41 -
- Tower Sites -
- ...Towers -
- ...pproximate Area ...ansion -

Fraser Valley System Reinforcement Project
McLellan 500kV Transmission Loop from 5L41
Possible Routing

Figure 2

2.2.2 Site 2 - Clayburn Substation

Alternative 2 is the existing Clayburn Substation. The proposed reinforcement would involve upgrading of the existing substation on lands already cleared and managed for the existing substation (Figure 3). Due to topography and soil conditions, the site requires considerable civil work in order to prepare the site for construction. This is not expected to have a significant incremental effect on biophysical resources of the substation area. Fisheries resources in Willband Creek are considered to be the central environmental concern. Although there are small forested areas within the B.C. Hydro property, no clearing will be required to accommodate the substation reinforcement.

There is limited potential for heritage resources to be found within the existing substation.

Land use impacts for this site are low due to the overall industrial nature of the site and adjacent uses (transfer station, existing substation, railway industrial lands). Some visibility concerns from residential, agricultural and hobby farm uses to the north, south and west may create indirect social impacts. Concern exists over the 500 kV loop into Clayburn substation which will cross the proposed playing fields to be constructed on reclaimed land, as well as the need to cross the Willband Creek Development permit Area.

2.2.3 Site 3 - Atchelitz Substation

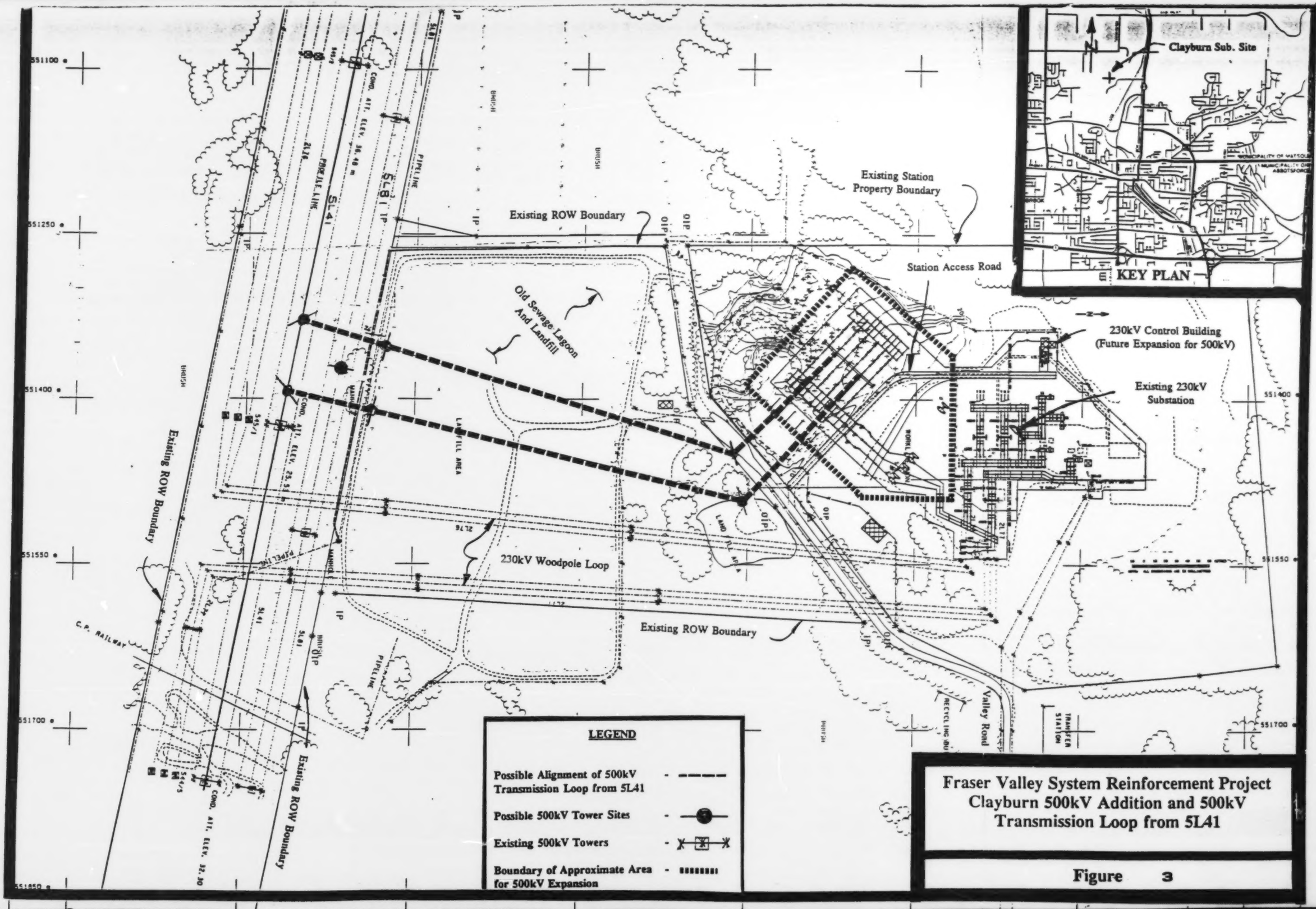
Atchelitz substation is located north of the Vedder River and west of Sardis, south of the intersection of Lickman Road and South Sumas Road. The existing substation property is approximately 5 hectares in size. To accommodate the proposed expansion, approximately 5.5 hectares of additional land will be required to the north of the existing substation boundary (Figure 4).

The expansion of the substation will require the use of land currently in agricultural use (pasture and cultivated crops). This land is considered highly valuable for agricultural use and is contained in the Agricultural Land Reserve. While not examined in detail, the potential impact stemming from the removal of this land from the existing farm operations could be substantial.

There are no recorded or reported heritage or archaeological sites present in the vicinity of the substation.

Wildlife and fisheries concerns are not present since there are no drainages in the vicinity of the substation and the surrounding land use is predominantly agricultural.

Due to the rural nature of the surrounding area and the existing presence of the substation and major transmission line corridor, visual impacts are considered low.



Fraser Valley System Reinforcement Project
Clayburn 500kV Addition and 500kV Transmission Loop from 5L41

Figure 3

1100' (335 m)

PROPOSED 500 kV ADDITION

Change Type 'D' to 'J' Dead-End 60'

N89°48'E

118/4 70/70 — 894.1' (272 m)

530/4 20/69 — 875.6' (267 m)

550' (168m)

N74°29'31"E

B.C.H. & P.A. R/W Boundary

118/4 78/70 — 1032.9' (315 m)

530/5 2A/69 — 1014.1' (309 m)

590' (180m)

℄ 5L81

℄ 5L41

45-5A

℄ 2L77

℄ B.C.H. & P.A. R/W Boundary

46/1A

EXISTING ATCHELITZ 230/69 kV SUBSTATION PLAN 37692

670' (204 m)

100' (30m)

ROAD

LICKMAN

118/3 7A/70

89.5'

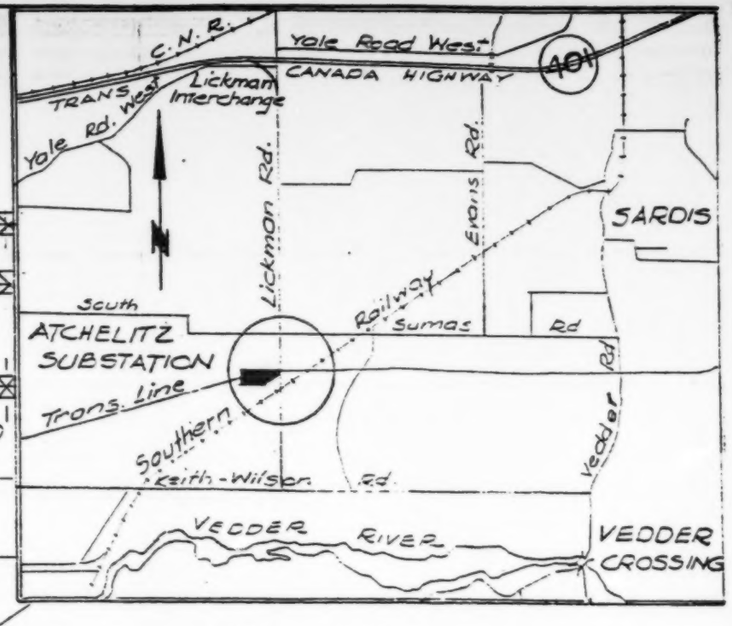
135'

126.5'

530/3 2J1/80

105'

SOUTHERN CROSS HYDRO ROW



KEY MAP
Scale: 1" = 1 Mile approx.

SUBSTATION

1. Proposal is to locate substation between the existing 230/69 kV substation and existing Circuit 5L41, and beneath existing Circuit 5L81.

TRANSMISSION

1. Change 530/4 (5L41) to dead-end.
2. Add 2W-OHGW from Str. 529/3 to 531/2 providing groundwire protection 1500 m to the east and 1680 m to the west, respectively.
3. Configuration of the 2W-OHGW on existing tower as shown on Figure 5.

DRAFT
MAR 01 1991

SCALE:
100' 0 100 200 300 400'
30m 0 30 60 90 120 m

FUNCTIONAL CODE 2.01

DESIGNED	SUBMITTED	SEAL	B.C.Hydro TRANSMISSION ENGINEERING DIVISION
DRAWN BG	INSPECTED		FRASER VALLEY REINFORCEMENT PROJECT
CHECKED DRAFTING	INSPECTED		ATCHELITZ 500 kV ADDITION & 500 kV LOOP FROM 5L41
CHECKED DESIGN	INSPECTED		
APPROVED		DATE	SCALE As noted — DWG. No FIG 4

R	No	REVISIONS	MADE	CHKD	SUBD	APPD	INSP	INSP	INSP	DATE

2.3 Comparison of Alternatives and Selection of Best Environmental Alternative

Each of the proposed reinforcement options were assigned a constraint rating according to environmental criteria. These constraint ratings are generally defined as follows and are considered within the context of this project only.

Low Constraint (L)

Areas where the proposed substation site would have little or no impact on environmental values or conflict with current ownership or land use patterns. These areas do not involve impacts that require significant mitigation.

Moderate Constraint (M)

Areas where environmental impacts require mitigation or where some losses or change of land use from current patterns exists; or, where some social or economic impacts on the area or properties are involved.

High Constraint (H)

These areas involve environmental impacts which would be difficult to resolve through mitigating design factors or which may require long-term mitigation activities and/or represent significant social or economic losses or land use impacts.

Table 1 illustrates a comparison of the overall environmental impact analysis.

The constraint ratings used in Table 1 provide an initial means of comparing the three project alternatives on the basis of the degree of impact and the effectiveness of available mitigation techniques. The high, moderate and low constraint ratings do not necessarily provide a weighting of each individual environmental factor in comparison to other factors. There are some factors which are considered of greater significance than others from the perspective of the degree of environmental impact. The McLellan Substation alternative, due to its proximity to the Nicomekl floodplain would potentially have significant impacts on the biophysical (fisheries, wildlife and vegetation) resources of the floodplain. This would potentially be the case for both the substation expansion as well as the 500 kV transmission line loop. In the case of the Atchelitz substation alternative, the most significant impacts are associated with the loss of prime farmland and the associated disruption to farming activities in the area. In addition, the requirement to utilize additional land for these two options beyond lands that are already utilized for existing substation purposes is determined to be a significant environmental detriment in the consideration of these options. The Clayburn site is already cleared and managed for the existing substation; any negative impacts resulting from the expansion would therefore be minimized. For those potential impacts outlined in Table 2 at Clayburn Substation there are no impacts considered to be the same degree of significance as those outlined for the other two options.

In comparing the three project options, due to the relative significance of the potential environmental impacts on fisheries, wildlife and vegetation at McLellan Substation, and agriculture at Atchelitz Substation as well as the low potential for impacts at Clayburn Substation, it is concluded that Clayburn is the environmentally best option for the project.

Engineering, financial and planning studies have also been undertaken by the project team. These studies, including the environmental assessment, when considered in total, favour Clayburn as the best alternative. Figure 5 illustrates the location of the existing Clayburn Substation, the area proposed for expansion and surrounding land uses.

Based on the selection of Clayburn as the best option, the remainder of this report will deal exclusively with an assessment of the environmental protection measures associated with the design, construction and operation of the reinforcement project at this location.

Table 1. **Overall Environmental Impact Analysis Rating for Transmission Line Reinforcement Alternatives (see definitions of constraint ratings)**

Factor / Site	Agriculture and Soils	Fisheries	Wildlife & Vegetation	Water use	Visual	Recreation	Land Use	Social Impacts	Planning/ Zoning	Economic Impacts	Heritage
McLellan	M	H	H	M	L	H	M	L	L	L	L
Clayburn	L	M	L	L	M	M	L	L	L	L	M
Atchelitz	H	L	L	L	L	L	M	M	M	M	L

PROPOSED B.C.HYDRO

FRASER VALLEY SUBSTATION REINFORCEMENT

CLAYBURN SUBSTATION SITE

Figure 5

LEGEND:

▪▪▪▪ Existing Rights-of-Way.

Proposed area for expansion.

-·—·- B.C.Hydro Clayburn Substation property.

Proposed 500kV Transmission Loop.

N

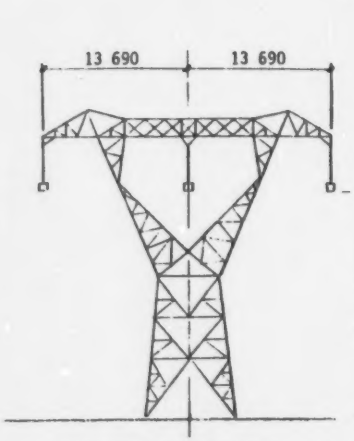
Scale: 0 200 400 600 m
500 1000 1500 2000 ft.

11 90

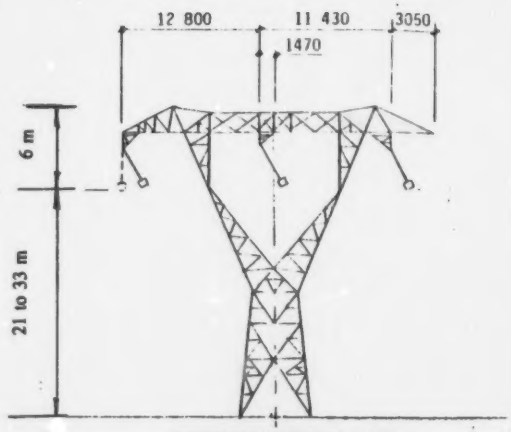
3.0 PROJECT OVERVIEW AND SCHEDULE

The Clayburn substation is already sized for expansion to a 500-230 kV substation and is technically well-suited for a 500 kV connection. The expansion is proposed for the southern region of the B.C. Hydro property. A loop off the middle 500 kV transmission line which runs in an east-west direction through the Fraser Valley would connect with the proposed 500 kV switching station to transmit additional power. These lines could be contained within the existing right-of-way and cross the reclaimed landfill site. Construction of the 500 kV loop would consist of two pairs of towers similar in appearance to those in the 500 kV transmission line corridor. An example of two possible tower structure designs are illustrated in Figure 6. The distance between the sets of towers would be approximately 100 to 250 metres. A more detailed explanation of the substation design is contained in Section 4.0.

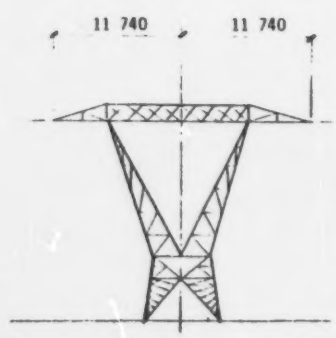
Planning, technical and environmental studies for the substation reinforcement project have been completed. An active public consultation program has been conducted over the last year and additional public consultation will take place in the Spring of 1991. The combined results of the studies and public consultation program will be included in B.C. Hydro's application for an Energy Project Certificate to the Minister of Energy, Mines and Petroleum Resources. This application will be made in 1991, with construction targeted to commence in 1993 for an October 1994 in-service date. Table 2 illustrates the two phases of the substation project schedule: 1) planning and development phase and 2) design and construction phase.



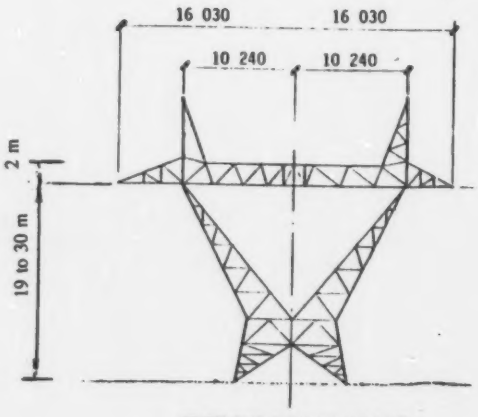
TYPE "A" STANDARD
SELF-SUPPORTING TOWER



TYPE "D" MEDIUM ANGLE
SELF-SUPPORTING TOWER

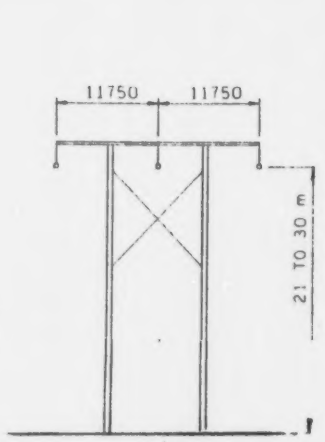


TYPE "J" STANDARD
DEAD-END TOWER

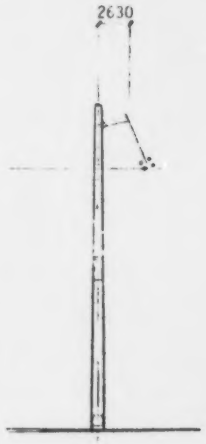


TYPE "K" HEAVY ANGLE
DEAD-END TOWER

LATTICE STEEL TYPES



POSSIBLE H-FRAME TYPE



SINGLE POLE/PHASE (3 PER STRUCTURE)
FOR ANGLES AND AS DEAD-ENDS

STEEL POLE "AESTHETIC" TYPES

Note: All dimensions are in millimetres
unless otherwise noted.

Fraser Valley System Reinforcement Project

Outlines of Various 500kV Tower Types
Lattice Steel and Possible Steel Pole Types

FIGURE 6

TABLE 2

FRASER VALLEY SYSTEM REINFORCEMENT - PROJECT SCHEDULE

Activity	1989	1990	1991	1992	1993	1994
Environmental, Technical and Route Studies and Public Consultation						
Design						
Equipment and Material Procurement						
Construction - Station						
Construction - T/L Loop						

4.0 BRIEF TECHNICAL DESCRIPTION OF THE PROPOSED SYSTEM REINFORCEMENT

The following section includes a brief description of the technical requirements and costs for the Clayburn substation. A more detailed technical examination of the expansion can be found in the technical report prepared by B.C. Hydro which has been prepared for the purpose of the Energy Project Certificate Application.

4.1 Location of Transmission Line and Substation Expansion

Figure 3 illustrates the location of the proposed 500 kV substation within the existing Clayburn site as well as the location of the 500 kV loop into the proposed substation from the existing transmission line corridor (5L41). The connection between the existing 230 kV substation and the proposed 500 kV substation is also illustrated.

The 500 kV transmission line loop is contained wholly within B.C. Hydro's existing right-of-way which also contains 230 kV circuits, 2L76 and 2L77 (wood pole). This alternative would result in towers being constructed on both the south and north side of the landfill.

4.2 Design

The design of the switchyard layout and structures is a compact prototype of a standard outdoor design. This newer design will minimize site development costs. Two additional feeders and a capacitor bank will be added to Clayburn Substation early in 1991. A 500 kV switchyard and the 500 kV line tap to the existing adjacent 500 kV circuit (5L41) are planned for a 1994 in-service. The existing property is intended to accommodate the development of the Clayburn Substation to an ultimate 500-230-60-25 kV capacity.

The transmission connection will consist of a "in and out" loop of 3-phase, single circuit 500 kV transmission from the existing 500 kV circuit 5L41. Circuit 5L41 is the middle transmission line on the transmission corridor located to the south of the Clayburn Substation site. The loop will connect to 5L41 at a location between structures 545/1 and 545/2 which are almost due south of the proposed substation expansion site. The loop will cross beneath the adjacent 500 kV circuit 5L81. It is estimated that each leg of the loop will require three towers, consisting of one dead-end and two lighter suspension towers. The two dead-end towers will be installed in the lead for 5L41 to tap into the circuit. The suspension towers will be installed either side of the land fill. The conductors will terminate on full tension structures within the station. Pile foundations consist of either timber piles or could be caissons or H piles, all of which support a concrete pile cap. A new suspension tower would be added into 5L81 between 133/1 and 133/2 to raise the conductors of 5L81 to permit crossings beneath.

Two overhead groundwires must be installed on the loop and for approximately 1,200 metres east and west on 5L41 from where the loop connects to the existing line. The groundwires are an extension of the station protection. This will involve adding supports for each groundwire to the existing tower. To provide the required protection, the groundwire will be added on 5L41 from structure 544/3 located one structure east of Hwy. #11 to structure 546/2 which is located west of Gladwin Road.

4.3 Construction Methods

4.3.1 Right-of-Way Clearing

B.C. manages an existing right-of-way which travels in an east-west direction through the Fraser Valley. In addition, B.C. Hydro also manages a right-of-way that branches north from the east-west right-of-way to the Clayburn Substation site. This right-of-way contains the existing 230 kV connection to the Clayburn substation. The present right-of-way is adequate for the proposed 500 kV loop from 5L41. Additional right-of-way clearing will not be necessary except for low isolated patches of brush.

4.3.2 Access Road Construction

Access road construction will require the import of sand fill as used for the 230 kV connections installed in the early 1980's. Culverts will be installed as required for drainage. The sand could be laid on fibre mats to minimize the spread and improve bearing capacity and could be removed upon completion of construction.

4.3.3 Structure Foundation Installation

Foundation installation necessitates the provision of access to each structure site. Road building equipment such as bulldozers, grader and construction equipment such as bulldozers, loaders, gravel and concrete-mixer trucks and material transporters will be required at each site. The standard of road construction will have to be sufficient to accommodate the listed equipment and at the sites, fill or rough grading will be required (rough levelled) to allow the equipment to be used on the site. Along with or immediately ahead of the site preparation crew, there will generally be a preliminary crew of a surveyor, chainman, and an operator with a small backhoe. This crew will lay out foundation excavations for size and depth.

For steel tower earth type foundations, excavations, setting and backfilling will be performed by a backhoe. The size of the machine will depend on the classification of structure.

Foundation steel for smaller lattice towers will usually be assembled in a central yard or yards on or near the right-of-way and main transportation routes. The larger lattice tower foundation grillages will be assembled on site. Delivery from the assembly yards to the sites of most

assembled smaller units and bundled material for larger grillages will be performed using an all-wheel drive heavy duty flat deck truck equipped with a deck crane.

In weaker soils such as peats and silts, steel lattice and steel poles will be set within steel caissons.

Equipment required for timber pile installation includes a pile driver of either drop or diesel hammer type capable of driving piles up to 15 to 20 m in length. For caisson installation a crane supports a vibratory hammer to drive the steel caisson pipe and must be large enough to lift the caisson into place and have enough reach to clear the hammer.

4.3.4 Structure Assembly and Erection

Tower construction requires the largest quantity of material to be delivered to the job site. Highway type trailers are generally used to transport bulk or pre-bundled tower steel or poles and associated material to a central yard or yards adjacent to the transmission line. The assembly areas must be wide enough to accommodate assembled components. Crane pads must accommodate the cranes (50-85 ton range) extended outriggers and be level (min. approximately 9 m x 12 m).

Steel assembly crews assemble tower components on site. For light self-supporting towers, assembly is generally performed by hand provided there is sufficient space to assemble and leave the components in place for the erection crew. For assembly of large self-supporting towers where space is limited, a 20 to 30 ton mobile crane will be used by the crew to assist in assembly of the heavy sections and to put assembled components aside.

The erection crew will consist of approximately ten men plus operators for a crane and bulldozer. Typically for most erection work a hydraulic boom, truck mounted type crane of 65 ton rating will be used.

Steel poles are erected in several pieces. Pole sections are laid out on the ground and jacked together at the slip joints or in sections assembling the structure as it is erected. A level working area the length of the pole and as wide as the structure is constructed in a similar manner as for lattice steel towers described above. If there are site restrictions the site access road can be used to assemble the pole and the crossarms can be added after the pole is erected or individual sections are assembled during erection which requires further jacking of the pole sections in the air.

On existing suspension structures (on 5L41) which are to have groundwire supports added, the existing outer crossarms will be removed and replaced with a new cross arm that has an outrigger to support the groundwire. On dead-end type structures lattice steel horns would be added on top of the existing crossarms.

In each case access is required to each tower and a work site must be prepared large enough to support one to two cranes and provide room for assembly of steel. The crossarms will be approximately 4 metres in length and 1.5 to 2 metres in width.

4.3.5 Conductor Installation

The mass of the major equipment required to deliver the conductor and perform the work make ground access to the right-of-way necessary.

The average conductor installation (stringing) crew will consist of approximately 10 to 15 persons, with a variety of equipment employed.

The stringing activity begins with upgrading of roads to provide ready access for light traffic to all possible sites and for heavy traffic (puller, tensioner and loaded reel trailers) to puller or tensioner set-ups locations.

Material supply and delivery for stringing will be much the same as for towers.

4.3.6 Site Restoration

Restoration work includes seeding, debris cleanup, road and work site removal. Equipment and labour consists of backhoes, small bulldozers, dump trucks, and pick-ups with operators and a few labourers. Seeding is performed by hand broadcast methods, with a helicopter or where special conditions warrants, a hydro seeding operation will be conducted.

4.3.7 Right-of-Way Maintenance

It is B.C. Hydro's policy that vegetation management techniques shall, wherever appropriate, protect and enhance desirable low-growing vegetation. To this end, all of the options that are available including physical (manual or mechanical), chemical, and/or biological controls will be considered. The methods used will depend upon site ecological characteristics, land use goals and engineering needs.

Herbicides are used to control unwanted, tall-growing, deciduous plants and prevent their regeneration and allow biological controls to be effective. Herbicide applications are regulated by the Pesticide Control Branch under the auspices of the Pesticide Control Act. The conditions of the particular Pesticide Use Permit are supervised by a certified pesticide applicator. B.C. Hydro will continue to maintain the existing right-of-way in the same manner. It is B.C. Hydro's stated goal to eliminate its' dependence on herbicides for vegetation management.

4.3.8 Substation Expansion

The existing 230 kV Clayburn substation will be expanded by adding two 500 kV line positions, a 500 kV switchyard, one 500-230 kV transformer bank and ties to the existing 230 kV switchyard. One control building similar to the existing building will also be added.

The expansion will be adjacent to and south-west of the existing fenced yard and within the B.C. Hydro property which was purchased in 1979 for ultimate substation development (Plates 4 and 5 - Appendix 1). In terms of area, the size of the station will be increased by approximately half for the 500 kV addition, leaving a similar sized area for future planned development.

4.4 Right-of-Way Requirements

The existing B.C. Hydro right-of-way is adequate for the 500 kV loop.

4.5 Substation Equipment

The 500 kV substation addition would include the following items of outdoor equipment in the switchyard.

1. Four 500 - 230 kV single phase transformers rated 200 MVA and arranged as a three phase bank with one spare. Each transformer tank and associated radiator bank would contain approximately 56,000 litres of highly refined, pure mineral oil for insulation purposes. Oil spill containment will be provided compatible with the site environmental assessment in compliance with B.C. Hydro's current practice.

2. Three 500 kV and two 230 kV outdoor circuit breakers. Each circuit breaker would contain a small quantity of low pressure SF6 gas for insulation purposes and either compressed air or hydraulic fluid for the operating mechanisms.

3. 500 kV current and potential transformers will utilize low pressure SF6 gas or pure mineral oil (less than 400 litres each) for insulation purposes.

4. 500 kV disconnects and surge arresters do not have any operating fluids.

5.0 ENVIRONMENTAL DESCRIPTIONS AND CONSIDERATIONS

The following section provides a synopsis of environmental, socio-economic and land use issues specific to the expansion of the Clayburn site and the 500 kV loop.

5.1 Climate and Air Quality

5.1.1 Climate

The Clayburn substation is located within the Pacific Climatic Region which is characterized by warm, rainy winters and relatively cool, dry summers. Average annual mean temperature for the area (recorded at the Abbotsford Airport) is 9.0 °C; average annual mean precipitation is 1502.4 mm; and the annual average frost free days are 169 days.

5.1.2 Air Quality

It is believed that there are no air quality issues relevant to the proposed project.

5.2 Topography, Geology and Soils

5.2.1 Topography

The Clayburn Substation site is characterized by gently sloping land. The area surrounding the site boundary contains areas of low level fields with rising topography to the south, north and west (plate 2 - Appendix 1). The area proposed for the expansion of this substation exhibits steep slopes to the east and west, largely a result of soil removal and deposition during previous construction activities.

5.2.2 Geology and Soils

The surficial geologic material at the Clayburn site is an eolian deposit of sand and silt overlying gravelly glacial outwash.

The area is predominantly characterized by moderately well drained soils with up to 5 cm of raw to well-decomposed organic litter on the mineral soil surface. This is underlain by 20-50 cm of weakly structured silty or very fine sand which is also found interbedded with the sands and gravel (plate 6 - Appendix 1). A small portion of the site contains soils of a more rich organic material, mainly reeds, sedges and grasses, which drains poorly and has slow surface runoff and high water holding capacity.

The abundance of gravel resources is quite apparent at the site; the Clayburn site was used for gravel extraction prior to B.C. Hydro's acquisition of the land and construction of the substation.

The soils of the low-lying area south of the substation which will be crossed by the proposed 500 kV loop consist of poorly drained organic and silt-rich soils probably of alluvial origin. These soils exhibit a water table at or near the surface for most of the year. The landfill area consists of a variety of foreign materials which have been dumped at the site and capped with till-like soils.

5.3 Land Use

B.C. Hydro owns the site on which the Clayburn substation is constructed. The land was purchased by B.C. Hydro in 1979 from the District of Matsqui. The site was previously an operating gravel pit. Lands south of Valley Road which are required for towers for the 500 kV connections to the existing transmission line are owned by the District of Matsqui. B.C. Hydro has a right-of-way through this area (see Figure 7). Adjacent land uses are primarily industrial and agricultural and are described below:

- North of the Clayburn substation are several rural residential/small agricultural parcels. These lots front on Downes Road, and consist of bush at the rear where they border the substation site.

- South of the site is the previous landfill site which is now being converted to public playing fields (plate 3 - Appendix 1).

- East of the site is the new Matsqui Solid Waste Transfer Station, with some vacant industrial parcels on the south side of Valley Avenue.

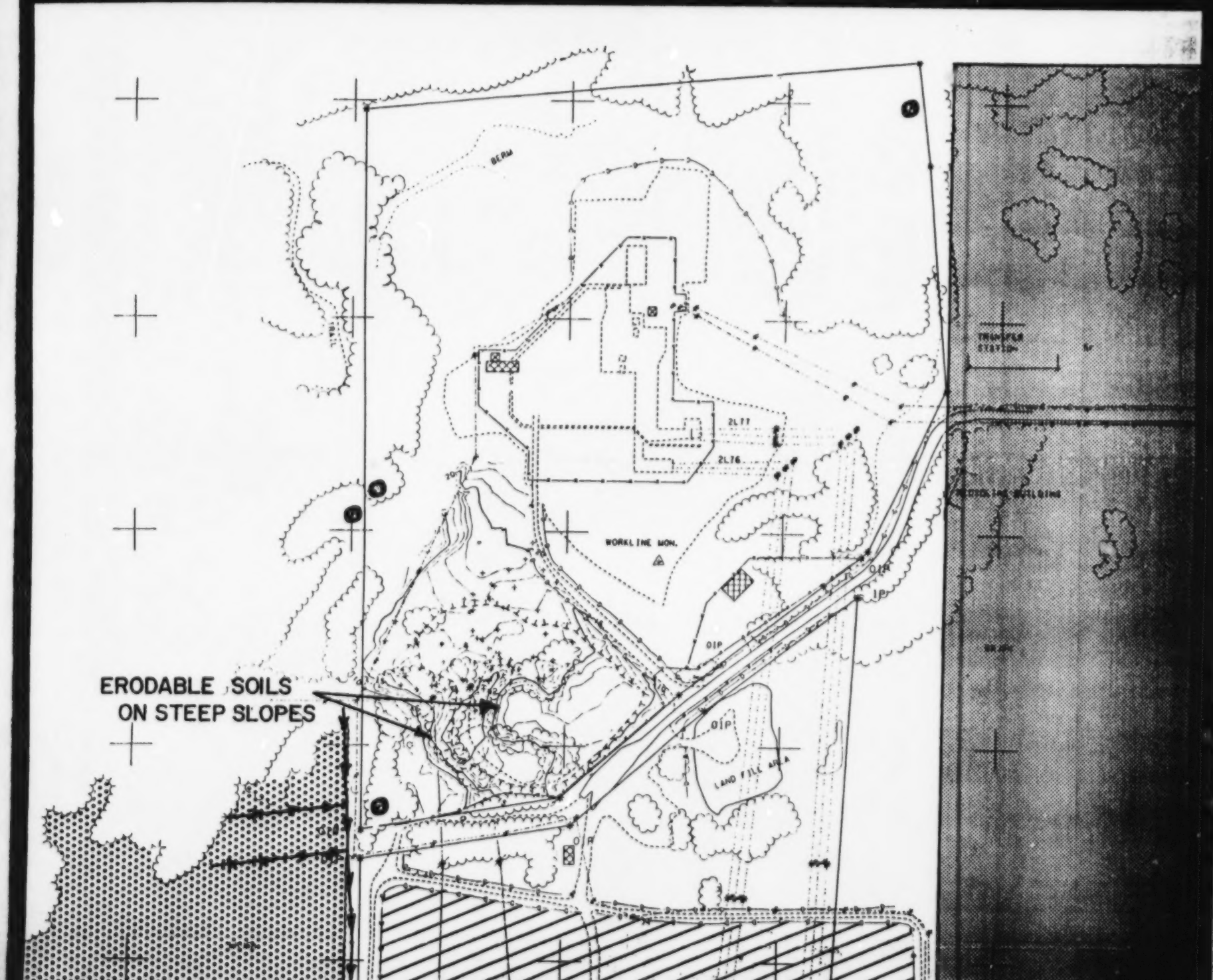
- West of the site the land is agricultural, with mixed bush and fields directly adjacent to the site boundaries.

The proposed expansion portion of the site is zoned Agriculture 3, and is designated Agricultural in the Official Community Plan; however the land has little or no value for agricultural production and is located outside of the Agricultural Land Reserve. The existing Clayburn substation is zoned for Public Use, as is the old landfill site south of Valley Avenue. The general area south of Industrial Road is zoned for industry and is designated as Matsqui Rail Industrial in the Official Community Plan. The location of the substation is suitable in terms of its compatibility with adjacent land uses, which are industrial in nature. A Development Permit Area (No. 21) for the Willband Creek Floodplain is located south of the substation expansion, in the existing right-of-way where the 500 kV loop will be constructed. Figure 7 illustrates the Development Permit Area for Willband Creek. Appendix 2 contains the description of the Willband Creek Floodplain Development Permit Area as contained in the Official Community Plan for Matsqui.

5.4 Water Resources

Willband Creek, located south east of the Clayburn substation, represents the major drainage basin in the area, flowing northward into the Fraser River. All of the study area drains into Willband Creek (Plate 1 -Appendix 1).

Within the Clayburn site there are 3 registered groundwater wells. An additional well is located immediately outside of the western boundary of the site. To the south east of the site, near the Canadian Pacific Railway right-of-way, 4 surface water licences exist. These surface water licenses will not be affected by the Clayburn expansion (see Figure 5).


ERODABLE SOILS
ON STEEP SLOPES
BERM
2L77
2L76
WORKLINE MON.
OIP
LAND FILL AREA

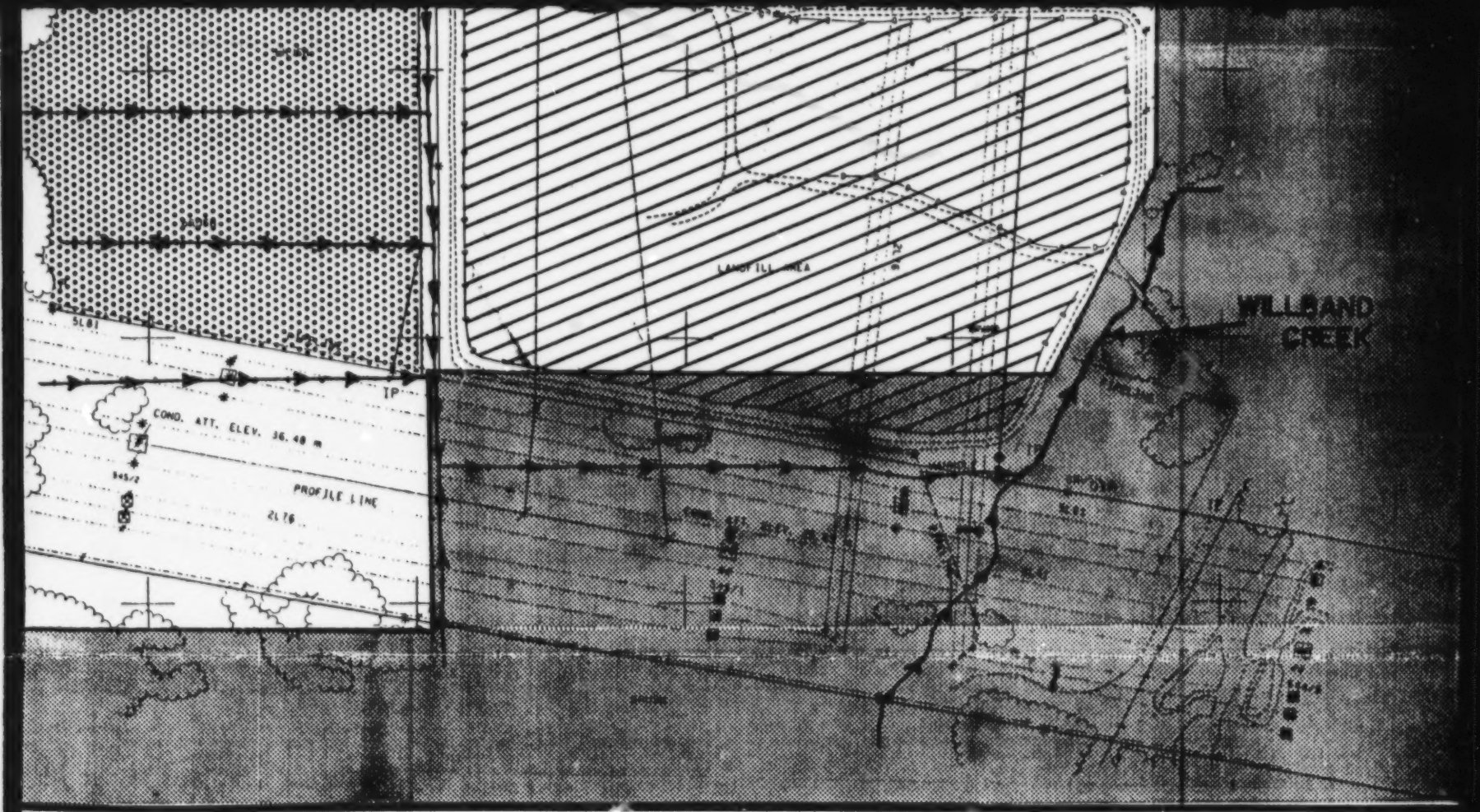


FIGURE 7. Environmental and Land Use Features of the Study Area

Willband Creek Floodplain Development Permit Area (District of Matsqui)

Cleared and Drained Farm Fields

Inactive Landfill Area

Surface Drainage Into Willband Creek

N

Registered Groundwater Well

SCALE 1:3,000

1·28·91

5.5 Ecology

5.5.1 Terrestrial

5.5.1.1 Vegetation and Forestry

The Clayburn site consists of small areas of forest and shrubs to the north and west, a playfield (reclaimed landfill and sewage lagoon area) and wet meadows. The wet meadows and shrub areas would be crossed by conductors linking the substation to the 500 kV line; however they are not expected to be affected by transmission line development. The wet meadows have previously been disturbed, possibly by attempts to farm the area.

5.5.1.2 Wildlife

Wildlife populations in the Fraser Valley area include black-tailed deer and small numbers of black bears. Deer populations have been reduced through habitat change and remnant populations are dependent on the remaining woodlots and riparian habitats for cover and food. The Clayburn site and the surrounding areas is rated under the Canada Land Inventory as moderate capability deer summer range (Class 3 and 4 complex). Furbearing species are relatively abundant in the Fraser Valley and have been able to coexist to some extent with the agricultural use of the region and other activities. These include coyotes and red fox, which are relatively abundant on the uplands, and beavers and muskrats along streams. Some limited trapping activity still occurs around streams. The Clayburn area contains some species of birds (raptors, songbirds, waterfowl in the floodplain of Willband Creek), small mammals (raccoons, muskrat, mink, rodents), and small numbers of deer. The wet meadows and forest/shrub areas have moderate value to wildlife; however they are not expected to be affected by substation construction.

5.5.2 Aquatic

There are no aquatic resources in the Clayburn substation area, however fisheries resources are found in Willband Creek which arises in the Abbotsford area south east of the Clayburn substation and flows northward, draining into the Fraser River. Willband Creek is reported to be productive, containing spawning coho and anadromous cutthroat trout and possibly steelhead. Willband Creek is considered sensitive to disturbance because of the occurrence of anadromous salmonids.

The section of Willband Creek that is near the substation is already extensively industrialized. Additional vegetation removal and/or water control in the floodplain for the purposes of right-of-way management are not expected.

5.5.3 Wetlands and Floodplains

There are no wetlands within the Clayburn Substation; wetlands are located within the Willband Creek floodplain south east of the Clayburn site. The Willband floodplain will not be directly affected by the expansion itself; however the 500 kV loop may cross the 100 year floodplain.

The land within the Willband floodplain contains ground water at or near the surface and is subject to periodic flooding. The floodplain functions as a natural storm water retention area and is required to remain in its natural state in order to minimize downstream flooding.

The Willband Creek Floodplain has been designated as a Development Permit Area (No. 21) in the Official Community Plan of the District of Matsqui (See Appendix 2). The objective of the development permit area is to protect downstream land and development from further flooding by preserving the natural drainage characteristics that control run-off and reduce storm water volumes and velocities. Any proposed development within the development permit area must be approved by the District of Matsqui and must follow any imposed guidelines.

5.5.4 Threatened and Endangered Plant and Animal Species

5.5.4.1 Wildlife

There are no known rare or endangered species (i.e. birds, mammals, amphibians, or reptiles) in the Clayburn area. The spotted owl is listed as endangered in the Fraser Valley; however, as it is associated with old growth stands of timber, and there are none on the Clayburn site, it is unlikely to be a concern for the expansion project. The Salish Sucker is listed as an endangered species in Canada and was noted to be present in some streams in the Fraser Valley area; however none has been identified in Willband Creek and therefore it is not considered a concern for the substation expansion project.

5.5.4.2 Plant Life

The B.C. Ministry of Environment has no rare, threatened, or endangered plant species listed for the area around Clayburn.

5.6 Socio-economic

5.6.1 Demographics

The District of Matsqui is one of the fastest growing regions in the Fraser Valley. Compared with the provincial average it has slightly more children, slightly less adults in all adult groups and more seniors. The area has experienced high rates of growth over the past 10 years, greatly

exceeding the provincial growth rates for the same period. A comparison of 5 year growth rates in population for Matsqui is shown in Table 3 below.

Table 3 Comparison of Growth Rates

	1976-81	1981-86
District of Matsqui	34.7%	22.5%
Province of B.C.	11.3%	5.1%

Within Matsqui, 52% of the adult population have graduated from high school, 14% of the adult population have attended university or graduated from university and 27% of adults have a trade certificate or diploma.

5.6.2 Economic Conditions

5.6.2.1 Overview of Area Economy

The largest industrial sector in the Matsqui area is the service sector (exclusive of retail trade) and employs 39% of the area's labour force. This is significantly lower than the provincial norm of 47%. Manufacturing and retail trade employ 13% of the labour force respectively which is comparable to the provincial average. Construction is slightly higher in the Matsqui area than the provincial average, with 8 to 10% of the labour force employed in this sector (6% provincially). There is significant agricultural activity in the area; agriculture is the fifth largest employment sector in Matsqui with 11% of the labour force employed (3% provincially). Wholesaling and warehousing represent the largest number of establishments in Matsqui, with mixed use light industrial parks second and wood and paper products third.

There has been a distinct increase in the rate of growth in dwelling units between 1981 and 1986 in Matsqui (27%). This rate of growth is continuing with 1,294 residential unit building permits issued in 1987, 1,097 in 1988 and 888 by September 1989. The average household income for 1986 in the Matsqui District is $30,390 which is lower than the provincial average of $33,512.

5.6.2.2 Economic Impact of Substation Construction

The construction of the Clayburn substation expansion will involve relatively few workers even during peak man-power requirements. The trades people required will be of specialized nature and consequently may be hired from outside of the area. Benefits to the local economy may accrue in the provision of accommodation, food services, general equipment supply and servicing

and provision of concrete products. In addition, local employment associated with non-specialized trades may increase. Table 4 outlines the labour force requirements for the Clayburn substation expansion. The total cost of the project is estimated to be $18.7 million.

5.7 Visual and Recreation Resources

5.7.1 Visual

The expansion of the Clayburn substation will be visible to viewpoints to the east, south and west of the site. The expansion will not substantially change the appearance of the landscape. The open space and minimal natural screening to the south of the expansion, coupled with the rising topography to the south, north, and west of the site, does however affect view sheds for several blocks. It is estimated that upwards of 100 residences would have a view of either or both of the new substation and the pairs of towers supporting the loop off the second 500 kV transmission line. In addition, a 52 unit townhouse development presently under construction and a proposed townhouse development may have views of the substation expansion and loop.

The boundaries of the view shed can be described as follows:

Northern boundary: Residences on Arcadian Way, south side of Seldon Road and south side of Downes Road west to Murphy Road.

Southern boundary: Residences along MacLure Road west of Highway 11 to 33000 block including Clearbrook Estates Trailer Park. Residences south of MacLure Road along Babich Street including Wren Crescent and Babich Place; includes Sherwook Hills condominium development.

Table 4 Labour Force Requirements

Clayburn Substation

CONSTRUCTION YEAR	*1993*	*1993 / 4*	*1994*	*1994*	*1994*
ACTIVITIES	*SITE PREP.*	*CIVIL CONST.*	*ELECT. CONST.*	*FOUNDATIONS*	*ERECTION / STRINGING*
CONTROLLING ORGANIZATION	*B.C. HYDRO*				
ORGANIZATION DOING WORK	**B.C. HYDRO** */CONTRACTORS*			*B.C. HYDRO / CONTRACTORS*	
PEAK MAN - POWER (A)	*6 + 1*	*8 + 1*	*10 + 1*	*10 + 1*	*15 + 1*
SKILLS (B)	*EQUIP. OPERATORS* *SURVEYORS* *LABOURERS* *TEAMSTERS* *INSPECTOR*	*INSPECTOR* *EQUIP. OPERATORS* *CARPENTERS* *LABOURERS* *SURVEYORS* *STEEL ERECTORS* *TEAMSTERS* *CONCRETE WORKERS* *BUILDING TRADES*	*WIREMAN* *LINEMAN* *EQUIP. OPERATORS* *EQUIP. TESTERS* *INSPECTOR*	*PILEDRIVERS* *LABOURERS* *SURVEYORS* *TEAMSTERS* *EQUIP. OPERATORS* *CARPENTERS* *INSPECTOR*	*LINEMAN* *STEEL ERECTORS* *LABOURERS* *TEAMSTERS* *EQUIP. OPERATORS* *INSPECTOR*
PRINCIPAL ACTIVITY CENTRES (C)	*ABBOTSFORD / MATSQUI AND AREA SURROUNDING CLAYBURN SUBSTATION*				
PROBABLE ACCOMMODATION	*LOCAL MOTELS / HOTELS FOR HIRES OUTSIDE THE AREA, OTHERWISE RENT OWN ACCOMODATION*				
TRAFFIC PATTERNS	*HIGHWAY # 1 AND HIGHWAY #11 PLUS LOCAL ROADS*				
ESTIMATED DURATION (months) (D)	*2*	*4*	*6*	*0.5*	*1*

NOTES:

A) Total contractor and B.C.H. Field Personnel
B) Does not represent Union Affiliation
C) Other minor centres may be affected
D) See Project Schedule for activity duration and period of effort

Eastern boundary: For substation/tower view, the most easterly house on MacLure Road and Wren Crescent south of MacLure. For 500 kV line reinforcement, west side of Parklane.

Western boundary: For substation/tower views, Malahat Place, Horn Street, Banff Place, Caithness Place and Old Riverside Road east of Banff Place. For 500 kV line reinforcement, residences backing onto transmission corridor one tower west of Gladwin Road, across from Chief Dan George School.

5.7.2 Recreation

The expansion to the Clayburn Substation will not affect recreation patterns directly, however the 500 kV loop may cross the proposed playing field complex (Figure 8). These fields are not yet in recreational use; however, if at the time of the substation expansion they are in use, some interruptions in their use may occur during the construction phase. Location of the towers for the 500 kV loop has been planned so that the proposed playing fields will not be disrupted. It should be noted that the use of the landfill area as playing fields is not certain and if this does occur, it will probably not happen for several years due to the need for the landfill to settle.

5.8 Heritage Resources

Previous extensive site disturbance combined with low lying landforms has resulted in a low potential rating for heritage resources in the Clayburn substation area. In general, the expansion will not likely impact any heritage sites; the exception may be in the south western corner of the proposed expansion site where one potential heritage zone exists which could be impacted by development.

5.9 Electric and Magnetic Fields

Concern has been expressed among members of the public, regulators and elected officials over the possibility that exposure to the electromagnetic fields associated with transmission and distribution lines could have the potential to adversely affect human health.

Wherever there is electricity, there are electric and magnetic fields. The names of the two fields are often combined and referred to as electromagnetic fields or EMF's, although each type of field has different properties. Electromagnetic fields that alternate or change polarity result from an alternating current, or "AC" source of electricity. In Canada and in the United States this change in polarity occurs 60 times per second (usually referred to as 60 Hertz). These fields are associated with all electrical appliances in homes and in workplaces, with the wiring that delivers electricity to houses and buildings, and with transmission lines.

Extensive studies have been carried out on the effects of these fields in humans, laboratory animals, isolated cells and tissues, and in livestock (both in the laboratory and in natural settings). Scientists have examined whether biological effects can be observed at electric or magnetic field strengths comparable to the highest levels that could be measured directly under a transmission line. In an effort to uncover any possible effects, further experiments have also been conducted, in laboratory settings, using field intensities much higher than those under transmission lines or that would ever be experienced by humans or animals in everyday life.

Two basic approaches have been used by scientists to explore electromagnetic fields:

1. Laboratory studies using human or animal experimental subjects, or isolated organs and cells.

2. Epidemiologic studies in human populations that look for an association between exposure to electromagnetic fields and various diseases.

Laboratory studies of humans exposed to intense electric and magnetic fields have not observed changes in basic physiologic processes (such as blood pressure, temperature, sleep, appetite and physical functions). Other studies have been conducted on mood and behaviour, and again these have not observed changes in humans.

However, these studies have documented that very strong electric fields can sometimes be felt, by the stimulation of body hair, much in the same way as we sense static electricity when combing our hair in dry winter weather. Other documented effects include minor changes in the brain wave activity seen when a person is exposed to light or sound. These minor changes are generally viewed as not harmful, and in these experiments the subjects' awareness, judgement and mood were unaffected. Similarly small was a change in heart rate of about 3 beats/minute, an amount comparable to that normally caused by a person taking a deep breath. This change was seen when subjects were exposed to strong electric and magnetic fields which were turned off or on. The change did not occur during steady field exposure.

A response that has been documented in laboratory rats is a decrease in the production of a hormone called melatonin upon exposure to electric fields. The significance of this response is unclear, and adverse consequences from this response have been reported.

Two recent epidemiologic studies of childhood cancer showed a weak correlation between cancer cases and proximity to certain types of distribution lines. However, no association was found between childhood cancer and measured magnetic field levels in this or any other study. In fact, the investigator who conducted the study observed that "...it should be kept in mind that we have not proven that magnetic fields cause cancer." The consensus of the World Health Organization, the New York State Power Lines Project, and Health and Welfare Canada, after evaluating all of the available data, is that no risk to human health resulting from exposure to electric or magnetic fields from power transmission lines has been established. A similar decision was reached by the B.C. Utilities Commission in July 1989.

CLAYBURN SUBSTATION PLAYING FIELDS Fig.8

Similarly, epidemiologic studies of the general health of workers exposed to electromagnetic fields examined physical and psychological well-being. These studies indicated that the workers were healthy and showed no indication of adverse effects from these exposures. Studies of the general population exposed to electromagnetic fields from power lines also did not show any increase in the risk of developing cancer.

Research has also been conducted to determine whether the health and reproduction of farm animals living near or directly under high voltage transmission lines is affected. These studies indicated that exposure to the fields associated with transmission lines is not harmful to farm animals. For example, the fertility and reproductive success of cattle either penned or grazing freely under 400 kV transmission lines in Sweden was not different from cattle maintained far away from transmission lines. Similarly, a study in Iowa found that the growth and reproduction of pigs over several generations was not affected by living under a 345 kV transmission line.

B.C. Hydro has recognized that there is widespread public interest in the issue of human health risks from electromagnetic fields. The Corporation has followed scientific developments, evaluated public and employee exposure, and participated in utility and technical forums on the subject. A full-time project manager has now been appointed to deal specifically with this important issue. In addition to internal technical experts, B.C. Hydro has also retained consultants with specific expertise to assist in evaluating research and providing advice on this matter.

B.C. Hydro, in recognition of concerns about EMF by the public, have taken practical steps to avoid exposing people by careful route selection using input from the public consultation process. In addition, line design modifications have been utilized that lower fields relative to older designs.

B.C. Hydro is committed to the search for a better understanding of EMF effects and will continue to provide the latest information to the public and its own workforce.

5.10 Radio and Television Interference

Based on previous experience with the operation of transmission lines throughout the province, B.C. Hydro believes that the proposed 500 kV Clayburn loop would not increase television interference along the right-of-way. Furthermore, Canadian Standards Association (CSA) Standard CAN3-C108.3.1-M84 states in Appendix E that generation of VHF noise (i.e. electromagnetic noise in the VHF television frequencies) is not usually an inherent property of a transmission line.

The CSA Standard includes a guideline for maximum radio noise of 57 dB at a lateral distance of 15 m from the outside conductor during fair weather. This same standard has been adopted by the federal Department of Communications in its proposed amendments to the radio

interference regulations. The calculated maximum radio noise at this same lateral distance from the proposed 500 kV Clayburn loop is 46 dB, which is below the CSA guideline.

During periods of rain, snow or fog, radio noise levels will increase but no guideline levels are provided in the CSA Standard.

5.11 Audible Noise

Audible noise from a transmission line generally has two components: a hum at a frequency of 120 cycles per second (120 Hz), and a crackling or hissing sound.

The magnitude of transmission line audible noise is closely related to weather conditions. Fair weather audible noise levels are normally very low and are rarely of concern. Audible noise significantly increases during and after rain from the water droplets on the conductor. During rain, much of the audible noise is masked by the noise of the rain itself.

Audible noise levels of the proposed 500 kV Clayburn loop at the edge of the right-of-way are not expected to exceed 48 dBA during rainy periods (worst case).

There are no CSA guidelines for audible noise; however, based on previous experience, B.C. Hydro is confident that the proposed 500 kV loop should cause little audible noise annoyance.

5.12 Special Considerations

To the south of the expansion is a proposed playing field. This field may be crossed by the 500 kV loop connecting with the substation expansion. The field is a former sewage lagoon/landfill site that was filled and capped in 1989. A site inspection has revealed that gas (type not known but probably hydrogen sulphide and possibly methane) is seeping and bubbling at the surface. In areas where the landfill is more recent, the smell of decomposing garbage is powerful. Construction of the 500 kV loop may require some mitigative techniques in order to protect workers. Appendix 3 contains the results of a preliminary investigation of the landfill site undertaken for B.C. Hydro by Western Research in February 1991. This study was designed to provide a cursory evaluation of the presence of volatile hydrocarbons in the vicinity of the landfill. The results of this investigation are that there is a high potential for flammable levels of volatile organic compounds near the centre of the landfill but a low potential near the edge of the landfill. The greatest concern is with any excavations required within the landfill area and subsequent worker safety.

The Clayburn site was previously operated as a gravel pit. During the initial construction of the substation some difficulties associated with soil erosion occurred. In order to avoid this problem, specific mitigative techniques may need to be implemented so that siltation into Willband Creek is avoided.

6.0 CONSTRUCTION AND OPERATION MITIGATION

As previously discussed in Section 2.0 and 5.0, the proposed expansion of the Clayburn substation is the most environmentally satisfactory location for the proposed transmission line reinforcement in the south central Fraser Valley. The surrounding lands where the expansion will occur are already cleared and managed for the existing substation. The 500 kV loop will be constructed in the existing right-of-way where the 230 kV connection is located.

In order to protect the environment and reduce land use and socio-economic impacts, there are a number of mitigation techniques which can be employed during construction and operation. This list of possible mitigation techniques is outlined below and is not intended to be exhaustive. It is anticipated that additional techniques or opportunities will be developed during the design and construction phase should the project proceed.

6.1 Water Quality and Use

- avoidance of any construction or clearing near surface or sub-surface wells.
- grounding of fences, metallic buildings, above-ground well sidings and spanning the wells and septic reservoirs.
- construction of the substation expansion, 500 kV loop and access roads should occur at least 10 metres away from the pipes and ditches located around the perimeter of the old sewage lagoon/landfill. This precaution would avoid the possibility of groundwater contamination.
- development of a drainage management plan prior to construction.

6.2 Fisheries

- adherence to established Department of Fisheries and Oceans and B.C. Environment Guidelines for streamside work (this may require application under the Water Act) when working near Willband Creek, this will be accomplished within the Environmental Protection Plan which will ensure compliance with government requirements and prevent impacts on this creek.
- where possible, any work activity carried out in proximity to Willband Creek should be completed within the appropriate construction window for the area. The general construction window has been jointly set by the provincial Ministry of Environment and Fisheries and Oceans as extending from July 1st or 15th (depending upon the timing of spring salmon runs) to approximately September 15. This time period falls between the spring and fall salmon runs, and is

generally a low flow period. Any revegetation in the vicinity of Willband Creek should be carried out during this time.

- no removal of riparian vegetation along Willband Creek.

- avoidance of construction during periods of heavy rainfall when working in close proximity to Willband Creek. This precaution will avoid possible stream sedimentation if stream banks should be disturbed. The use of a sediment (silt) setting pond should be considered to ensure that any sediment produced during construction does not enter Willband Creek.

- use of vehicles or heavy equipment during construction, ongoing maintenance activities and refuelling of vehicles should occur a minimum of 30 m from Willband Creek and ditches in order to eliminate the possibility of fuel leaks or spills.

- ensure that herbicides are not used near streams or drainage ditches flowing into Willband Creek.

- re-contouring and revegetation of disturbed soils, particularly on the substation site where steep, erodible soils occur, should be undertaken immediately following construction and within the same growing season and should be incorporated into the drainage management plan referred to earlier.

6.3 Floodplain Management

- compliance with guidelines issued by the District of Matsqui for the Willband Creek Floodplain Development Permit Area No 21 when constructing the 500 kV loop.

- minimize the amount and ensure the careful selection of the type of fill needed for work activity near Willband Creek in order to reduce the possibility of increased sedimentation and possible flooding.

- in order to avoid possible flooding downstream on the Willband Creek floodplain caused by a decrease in water storage capacity, remove all fill deposited for access road and construction purposes.

6.4 Wildlife

- examination of the site before construction to determine if any nesting sites of raptors or water fowl exist; construction activities must ensure that habitat disturbance would be minimal.

- minimize disturbance to the forest/shrub area in north east corner of the Clayburn site.

6.5 Socio-economic and Land Use

- continue communication with area residents and property owners to clarify plans and impacts of the substation expansion.

- placement of towers along property lines rather than mid-property.

- use of local labour and suppliers of goods and services where possible.

6.6 Visual and Recreation

6.6.1 Visual

- retention of natural tree cover and the use of selective planting to screen the lines from residences and/or travelled roadways where feasible.

- construction of the two lines of the loop should occur as close together as possible in order to reduce visual impact (minimum distance between the two lines must be 40 metres for safety reasons).

6.6.2 Recreation

- the proposed playing field south of Valley Road has not been included in the Official Community Plan nor the Public Works 10 year budget. Two other sites have been identified that are better suited for playing field development. Both are former landfill sites; however, unlike Clayburn, they have been compacting for several years. The Clayburn site was only filled in last year and will require several years for settlement and methane gas dispersion. In addition, the playing fields near Clayburn are not within walking distance of the majority of the community, and the overall industrial nature of the area is not compatible with recreation activities.

- if playing field development is expected to proceed, changes in the location and orientation of the fields may be required in order to avoid tower bases and possible conflicts between uses of the playing fields and the overhead transmission lines. In addition, if at the time of construction of the expansion the fields are in recreational use, scheduling of construction should be sensitive to heightened playing field use in order to minimize interruptions to users.

6.7 Heritage Resources

- detailed site examination of the south west corner of the Clayburn expansion area should be undertaken by a qualified archaeologist. The investigation would require evaluative testing; a more detailed systematic data recovery (excavation or collection) would be required if test results indicated the presence of significant heritage resources.

- examination of possible heritage resources located in the right-of-way; spanning and/or other protective measures could be undertaken to mitigate any negative impacts.

6.8 Electric and Magnetic Fields

- maintain present commitment of B.C. Hydro to the search for a better understanding of EMF effects and the provision of the latest information to the public and its own workforce.

6.9 Special Considerations

- determination of any potential dangers from seeping gas from old sewage lagoon/landfill inherent in construction and operation of the 500 kV loop and possible need for control of gas seepage before construction occurs.

- determine status of landfill with respect to ground stability; if ground is considered a soft and unstable land base for tower construction, special engineering may be required to ensure adequate foundations.

- special attention should be given to excavation of the expansion site and removal of silt deposits to avoid silt washing down local ditches causing increased sedimentation of Willband Creek. Possible mitigative measures to improve drainage and prevent silt run-off and stream sedimentation include: application of a gravel layer on the construction site, installation of additional drainage ditches and culverts, installation of effective filtering systems, and seeding and possible re-contouring of unstable slopes.

- special consideration should be given to the construction of access roads and tower foundations. Restoration of disturbed ground should occur immediately following construction to avoid runoff of silt and increased sedimentation. Mitigative techniques could include re-contouring of steep slopes, increasing drainage by construction of ditches, re-seeding and re-vegetating cleared or disturbed areas.

- An oil spill containment plan shall be devised that will ensure that the loss of oil from the site is adequately cleaned up; the containment plan shall ensure that no oil is capable of entering Willband Creek.

- a detailed environmental protection plan will be prepared.

7.0 CONCLUSIONS AND RECOMMENDATIONS

On the basis of the environmental assessment and mitigation procedures to be employed for this proposed project, the following conclusions and recommendations are reached:

1. The use of the existing Clayburn Substation for the 500 kV substation reinforcement is the environmentally best option in the context of the three options examined.

2. The most significant environmental issues are:

   i) fisheries resources and stormwater control features of Willband Creek;

   ii) visual impacts to the surrounding residences and potential recreation use of the landfill;

   iii) worker safety in the vicinity of the landfill site due to the presence of flammable and asphyxiant gases; and

   iv) recreation impacts regarding the future use of the landfill area for playing fields.

3. The preparation of an Environmental Protection Plan, that will include, among other items, a drainage management plan and an oil spill containment plan for the design, construction, operation and maintenance of the substation expansion and 500 kV loop should be undertaken. This document will provide the details of mitigation techniques that will reduce or eliminate potential environmental impacts.

APPENDIX 1. Photographs of the Clayburn Substation area

APPENDIX 1

LIST OF PLATES

Plate 1	Willband Creek floodplain; looking west within existing right-of-way.
Plate 2	View southwest from proposed site for 500 kV substation; left side of photo shows landfill site and right side are the existing farm fields; existing right-of-way is in the background.
Plate 3	View north across landfill site toward proposed site for 500 kV substation in background (higher ground).
Plate 4	View north from proposed site for 500 kV substation to existing Clayburn Substation.
Plate 5	View south from existing Clayburn Substation to proposed site for 500 kV substation.
Plate 6	Erodible soils on steep topography south of proposed 500 kV substation.

Plate 1. Willband Creek floodplain; looking west within existing right-of-way.

Plate 2. View southeast from proposed site for 500 kV substation; left side of photo shows landfill site and right side, the existing farm fields; existing right-of-way is in the background.

Plate 3. View north across landfill site toward proposed site for 500 kV substation in background (higher ground).

Plate 4. View north from proposed site for 500 kV substation to existing Clayburn Substation.

Plate. 5. View south from existing Clayburn Substation to proposed site for 500 kV substation.

Plate 6. Erodible soils on steep topography south of proposed 500 kV substation.

APPENDIX 2. Willband Creek Floodplain Development Permit Area

H. DESIGNATION OF DEVELOPMENT PERMIT AREAS

Section 945(4) of the Municipal Act authorizes local governments to designate areas in the Official Community Plan for the

(a) protection of the natural environment
(b) protection of development from hazardous conditions
(c) protection of provincial or municipal heritage sites
(d) revitalization of an area in which a commercial use is permitted, or
(e) establishment of objectives and the provision of guidelines for the form and character of commercial, industrial or multi-family development.

Where an area is designated, land development and construction shall only take place after a development permit has been issued by Council.

Where Council has designated lands under categories (a) and (b) above, these are the only lands so identified to date. This Plan should not be construed to mean that all other lands are free of such environmental or hazard problems.

The following development permit areas are hereby designated:

DEVELOPMENT PERMIT AREA NO. 21, as per Map M-420, Sheet 21

Name: Willband Creek Flood Plain Development Permit Area

Category: "a" (Natural Environment)
"b" (Natural Hazard)

Justification: Most of the land included in the Willband Creek Flood Plain Development Permit Area has been identified as being within the 100-year flood plain. The land contains ground water at or near the surface and is subject to periodic flooding. It functions as a natural storm water detention area and is required to remain in its natural state in order to minimize downstream flooding. As such it must remain free of further development, including any deposition of fill or other material, except where equivalent additional water storage capacity is provided by way of excavation elsewhere within the development permit area. The objective of the development permit area is to protect downstream land and development from further flooding by preserving the natural drainage characteristics that control runoff and reduce storm water volumes and velocities.

Guidelines: Development permits issued in this area shall comply with the following guidelines:

1. The deposit of soil or fill material, recontouring or building construction shall not take place where it would reduce the storm water detention capacity of the Willband Creek flood plain, as defined on Map M-420, Sheet 21.

2. No building permit shall be issued, and no land clearing, recontouring, removal of soil or vegetation, or the deposit of soil or fill material of any kind shall be carried out within the development permit area until a development permit has been issued outlining appropriate measures to preserve the storm detention capabilities of the area and to protect the creek and its flood plain from erosion, siltation, degradation and any harmful effects of adjacent development.

3. No structures or paved surfaces shall be permitted in any area subject to damage from flooding.

4. Buildings, structures, paved surfaces, and any underground drainage facility or tile field shall be located at such a distance from the creek and storm detention area as to minimize run-off and siltation, and the possibility of erosion or sloughing. Any necessary sediment barriers or other containment measures shall be in place at the clearing and construction stage.

5. Every application for a development permit shall be accompanied by plans showing any works and measures to be carried out under the permit to satisfy the above-mentioned objectives, which plans shall be signed and sealed by a Professional Engineer licenced to practice in the Province of British Columbia. The Professional Engineer will certify that the works and measures detailed in the plans shall be sufficient to satisfy the said objectives, shall attest that he will supervise and has been authorized by the Developer to supervise the carrying out of such works and measures to ensure that they are

carried out in accordance with the said plans and the terms of any development permit issued hereunder and, upon completion of the said works and measures and prior to the issuance of any building permit on lands which are subject to a development permit issued hereunder, shall certify that all such works and measures have been carried out in accordance with the said plans and the terms of the said development permit.

Application Submission Requirements: Every application for a development permit shall be accompanied by:

1. Plans showing works and measures to be carried out in accordance with the above-mentioned Guideline No. 5.

2. A site plan showing buildings and structures, parking areas, access and the top of the bank defining the channel of Willband Creek.

3. A plan showing existing and proposed grades.

4. A plan showing selected cross-sections through the site.

5. Other information as may be necessary to assess the development proposal.

DEVELOPMENT PERMIT AREA NO. 21

WILLBAND CREEK FLOODPLAIN

DWG. NO. M-420 SHT. NO. 21

BY-LAW NO. 3305 REV.

THE CORPORATION OF THE DISTRICT OF MATSQUI

— OFFICIAL COMMUNITY PLAN —

DRAWN:	APPROVED:
90 03 15	90 05 14

APPENDIX 3. Investigation of Volatile Organic Compounds at the Matsqui Landfill Site

Western Research
A member of the BOVAR group

February 13, 1991

Mr. Mark Walmsley
B.C. Hydro
Environmental Resources
1312 - 808 Nelson Street
Vancouver, B.C.
V6Z 2H2

Dear Mr. Walmsley:

Re: Total volatile organic hydrocarbon monitoring at the Matsqui landfill capped site

On October 7, 1991 Western Research conducted monitoring for total volatile hydrocarbon at the Matsqui landfill. The method used for this testing was a hydrogen enriched flame analyzer. The analyzer reports any readings in parts per million (ppm) and has a range of 0 - 1000 ppm full scale.

At the site, the analyzer was set to read zero by using a hydrocarbon kicker to scrub out any hydrocarbons present in the ambient air. Following the zeroing of the analyzer the scrubber was removed, the analyzer was then walked across the proposed power line location. Readings were taken every 7 meters at ground level, 1 meter above the ground and around the perimeter of the site. Please refer to Map A for site location and Table A for concentration values.

Due to the nature of a landfill site, many compounds exist that could expose the worker to contamination. Although B.C. Hydro has no intention of drilling any piles into the capped site they plan to drill on its perimeter. As the test results indicate the perimeter of the capped site does have some seepage of volatiles. If B.C. Hydro is to continue with its' proposed sites, Western Research recommends that prior to drilling more extensive testing should be conducted. Further testing would allow the qualification and quantification of all volatiles, as well as determining other possible contaminants.

We have included a Table (5) taken from "Industrial Health & Safety Regulations". Capped landfill sites may have high concentrations of methane.

201, 267 West Esplanade, North Vancouver, B.C., Canada V7M 1A5 Telephone (604) 984-4450 FAX (604) 984-9985

We trust this is the information you require. Please feel free to contact us at 984-4450 should you have any questions regarding the above.

Yours truly,

B Reshetylo

Brad Reshetylo
Environmental Technologist

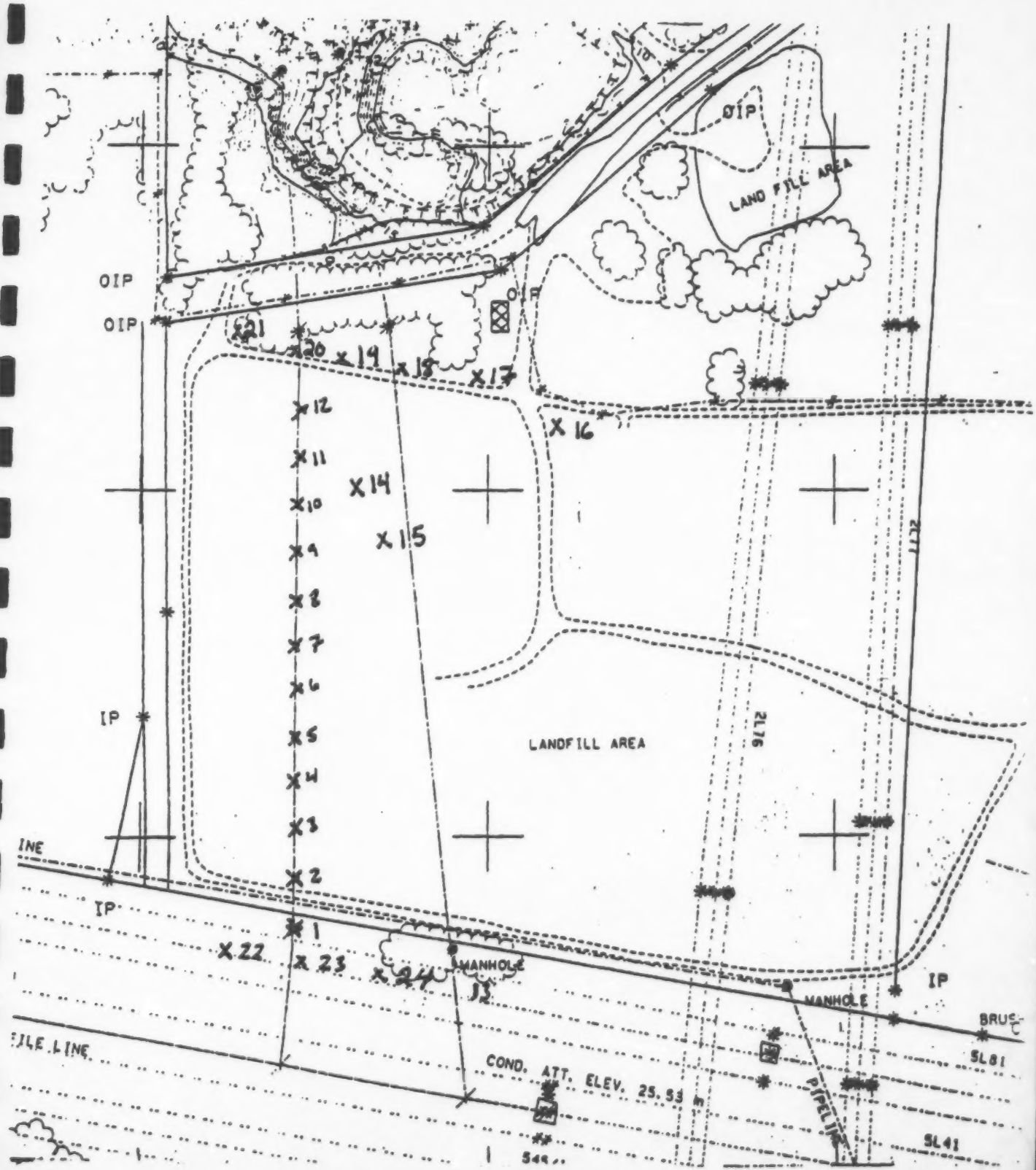
BR/hjg

TABLE A

MONITORING SITE	CONCENTRATION (PPM)
1	80 - 100
2	200 - 250
3	200 - 250
4	0 - 100
5	20 - 100
6	130 - 200
7	340 - 500
8	600 - >1000
9	200 - 300
10	200 - 300
11	300 - 500
12	100 - 200
13	20 - 250
* 14	>1000
15	300 - 500
16	200 - 300
17	100 - 150
18	100 - 150
19	100 - 150
20	60 - 100
21	0 - 60
22	20 - 100
23	100 - 120
24	100 - 250

* Reading taken from cracks around a ground well

MAP A


OIP
LAND FILL AREA
OIP
OIP
OIP
X21
X20
X19
X18
X17
X16
X12
X11
X14
X10
X15
X9
X8
X7
X6
IP
X5
LANDFILL AREA
X4
X3
X2
INE
IP
X1
X22
X23
MANHOLE
MANHOLE
IP
BRUS
SL81
ILE LINE
COND. ATT. ELEV. 25.53 m
PIPELINE
SL41
2L77
2L76

APPENDIX "A" (CONTINUED)

TABLE 5

ASPHYXIANT SUBSTANCES WHICH MUST BE CONTROLLED TO ENSURE THAT NO ATMOSPHERE IS OXYGEN DEFICIENT (LESS THAN 18% OXYGEN) AT ANY TIME

Acetylene
Argon
Ethane
Ethylene
Helium
Hydrogen
Methane
Neon
Nitrogen
Propane
Propylene

TABLE 6

MAXIMUM ACCEPTABLE BODY BURDENS

Substance	Maximum Concentration Blood µg/100 ml	Urine µg/l*
Arsenic	50	1500
Cadmium	10	35
Lead inorganic	80	200
alkyl compounds	—	160
Manganese	—	75
Mercury inorganic	—	500
alkyl compounds	—	40
Vanadium	—	150
Selenium	—	300
Fluoride	—	5000**
Carbon Monoxide	10% as carboxyhaemoglobin	—

* corrected to SG 1.024

** samples collected 48 hours after last exposure

Western Research
A member of the BOVAR group

19 February 1991

Mr. Mark Walmsley
B.C. Hydro
Environmental Resources
1312 - 808 Nelson Street
Vancouver, B.C.
V6Z 2H2

Dear Mr. Walmsley:

Re: VOC Sampling February 7, 1991 - Recommendations on Worker Exposure.

Working around a capped landfill involves a potential for exposure to flammable vapours and toxic gases. Matsqui's landfill cap layer exhibited a high potential for flammable levels of volatile organic compounds near the top. The survey points around the dump site's edge did not show a potential for sufficient concentrations to reach hazardous levels. The following table provides the flammable range for the main constituents of landfill gases:

	LFL %	HFL %	Odour Threshold
Ethane	3.2	12.5	odourless narcotic
Methane	5.5	--	odourless asphyxiant
Propane	2.3	9.95	odourless asphyxiant
Hydrogen Sulphide	4.3	46	.008 ppm asphyxiant

- L or H FL are lower and higher flammable levels
- 1% is equal to 10,000 parts per million

The wind provides sufficient ventilation, with respect to the levels found, for general protection from the asphyxiant or narcotic natures of the flammable gases. At the present vents, the highest concentrations observed were greater than 1,000 ppm. With the construction, venting may occur along the formwork. There is potential for an explosion and further testing and adherence to WCB Regulations, Section 12 may be required.

201, 267 West Esplanade, North Vancouver, B.C., Canada V7M 1A5 Telephone (604) 984-4450 FAX (604) 984-9985

Hydrogen sulphide is an odour irritant and asphyxiant that causes respiratory failure. The odour threshold is very low and the 8 hour threshold limit value is 10 ppm. Levels observed that day were well below the TLV. I feel that hydrogen sulphide could be a concern if drilling is done.

During construction, simple Gastec tube sampling or personnel monitors should be used to ensure levels continue to be below hazardous levels.

If speciation of the volatile compounds is required or information is needed on protective respirators, please feel free to contact us at 984-4450.

Yours truly,

Randy Visser

Randy Visser,
Environmental Technologist

RV:jj